(Wallace)

MFE

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THE

AMATEUR PHOTOGRAPHER.

A MANUAL

OF

PHOTOGRAPHIC MANIPULATION.

INTENDED ESPECIALLY FOR

BEGINNERS AND AMATEURS.

WITH SUGGESTIONS AS TO THE CHOICE OF APPARATUS AND OF PROCESSES.

BY

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PHILADELPHIA:
PORTER & COATES.

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AMATEUR PHOTOGRAPHER.

CHAPTER I.

INTRODUCTORY.

PHOTOGRAPHY cannot offer any exception to the rule that all beginnings are difficult. But still, a modicum of attentive study so planned as to be carried on intelligently and to master *principles*, coupled with the desire of doing really good work, will soon surmount the initiatory troubles. The *technique* having once been acquired, the field will open in ever-widening circles to the more essentially artistic kinds of work. The man of a mathematical turn of mind will find much to interest him in the Optical department, just as the experimentalist will in the deep and obscure Chemical problems of the Dark Room.

But the great beauty of the art does not consist in this—that negatives delineating every twig on every tree of the mountain-side with

painful sharpness and accuracy may easily be made, or that Instantaneous pictures of the race-horse's leg may be taken with absolute truth; it is rather in the fact that the man of artistic taste is furnished with a new resource, whose marvellous power and extended range of applicability can never be fully realized until taken in hand, and conscientiously tried.

The advent of the Gelatino Bromide Process with its ready-prepared plates and outfits specially arranged for them has called forth a large number of new workers. Some of these may complain of the study and toil involved in the arrangement of a good composition—quite as much, in many cases, as if pencil or brush were employed—and some even, when their first ardor has been cooled by failures, will further complain that it is hardly worth while to waste trouble on an Art dealing in monochrome exclusively. Let such as these be reminded of the sublime effects produced by great masters with the help of one color only. And another word to the new-comers: Let them not ignore all the older processes and pass them by as unworthy of attention. No greater mistake could be made. Where it is a question of instantaneous exposures, Gelatine is *facile princeps*, but for ordinary time-pictures

the results given by Gelatine are not one whit better than those of any good standard Dry Plate; so that the matter actually reduces itself to this—that the great recommendation of Gelatine Plates is the fact that they are more sensitive and may be bought ready made; or, to put it in other words, that the photographer has a large and interesting share of his own proper work done for him by the manufacturer. When we seek simply for the best chemical effect in a photograph that our present knowledge enables us to make, we find it—just where we might expect—in the standard Wet Collodion Plate. But this is not to be understood in the light of an attack upon the wonderful process which has wellnigh revolutionized Photography, or as a sneer at those who are glad to take up the camera as a means of recreation from serious labors, and to whom the trouble of preparing their own sensitive plates might be the cause of their abandoning the Art. Let them rather be congratulated that things are made as easy for them as they are, and that the mechanical obstacles to really tasteful and artistic efforts are reduced to a minimum.

The value of the Photographic Camera in tempting forth those who lead confined lives into the fresh air of the woods and fields is

becoming more and more felt every day, and those who once experience the pleasure of out-door photographic trips with a few congenial spirits, will in after-years look back with no ordinary fondness upon the perhaps crude beginnings of their career, and without doubt seek fresh opportunities of repeating their photographic excursions.

CHAPTER II.

PHOTOGRAPHIC APPARATUS.

Lenses.—Before proceeding to speak of the different varieties of Photographic Lenses, it will be well to classify them in two divisions: 1. Aplanatic Lenses; 2. Non-Aplanatic Lenses.

To the first class belong the Portrait Lenses proper and a great variety of most highly useful doublets, such as Dallmeyer's Rapid Rectilinear, Ross's Rapid Symmetrical, Steinheil's Aplanatic, the Euryscope, etc. An Aplanatic Lens is one that can be used for photographic purposes with *full aperture—i. e.*, without a diaphragm or stop; or, in other words, one which, in giving an image sharp enough for practical purposes, utilizes the utmost possible amount of light.

To the second class belong such lenses as are required to cover a larger field with absolute sharpness and include a wider angle, as is very often necessary in Landscape and Architectural Photography. Such are Dallmeyer's Wide Angle Rectilinear, Ross's Portable Sym-

metrical, Zentmayer's Lens, and all the View Lenses proper,* which are Meniscus Lenses made in various ways. These give extremely sharp pictures according to the diaphragm used, *but can never be worked with the full aperture,* the construction of the lens not admitting it.

It is manifestly impossible to mention the names of all the different lenses manufactured at the present day, but a few words of advice may be given to those who are in doubt as to the form best suited to their purposes; and the following, which was penned many years ago by the eminent writer the Rev. T. Frederick Hardwich, may be properly quoted here: "As this Work is addressed principally to one about to commence the practice of Photography, let the Writer advise him not to be induced by the hope of obtaining large pictures to purchase a photographic apparatus of a very considerable size; he will find that plates above ten inches by eight will involve an amount of baggage which in travelling becomes a bur-

* It is hardly possible to make such a classification with perfect accuracy. The ordinary Meniscus View Lens covers about the same angle as the Rapid Rectilinear, but has the double drawback of not being aplanatic and of giving barrel-shaped distortion. An excellent form of Meniscus View Lens is the "Wide Angle Landscape" of Dallmeyer, which, from its very ingenious and peculiar construction, includes a wider angle than any other Meniscus.

den;" and Mr. Dallmeyer, the celebrated optician, says: "In recommending the smaller-sized plates, it may be well to remind the amateur that not only do the difficulties of manipulation greatly increase with any increased dimensions of plate, but that the quantities, weight, bulk, etc., of all the other necessary appliances become augmented also, and this in the proportion of more than the *square* for every increase of size of plate."

A deservedly favorite form of outfit is a camera for plates 4 inches by 7, or 5×8, which can either be used for stereoscopic work with a pair of lenses, or, by removing the central septum and substituting a front panel with a single lens, may make a single picture the full size of the plate. As it will doubtless be desired to make both portraits and views, a pair of matched Aplanatic Lenses of about 6 inches focus should be chosen, with another lens of from 7 to 11 inches focus for working on the full size. A pair of Dallmeyer's 6-inch Rapid Rectilinears with a 7-inch Wide Angle Landscape, or 8-inch Rapid Rectilinear by the same maker, or a set of Ross's Rapid Symmetrical Lenses of the same focus, would constitute an excellent outfit. Many good lenses, however, may be had for a less price than is charged in this

country for the above-named, particularly those by French and German makers; and there are also very good instruments of American make. It has long been the custom of some of the French opticians to send out lenses with one or more supplementary attachments by which the focus of the principal lens can be shortened or lengthened, thus giving virtually two or three lenses in one; so that both views and portraits may be made with a single instrument. Where economy must be rigidly consulted, it would be well to make trial of these very ingenious French lenses.

The merits of a lens will be put to a severe test in Architectural Photography, where a wide angle of view is often necessary, as well as great sharpness and perfect freedom from distortion. All single lenses of the meniscus form are subject to what is known as "barrel-shaped distortion," all straight lines near the margins of the picture being curved inward. It is obvious that this does not in the least injure the lens for Landscape Photography, where absolutely straight lines of any kind are seldom or never met with, while it would entirely spoil the appearance of an Architectural photograph. The proper lenses for this latter class of work are the non-distorting Doublets, already men-

tioned, which can also be used for landscapes and groups, or even for portraits in a good light. If extra-rapid Gelatine plates be used, they can also be made available for Instantaneous Photography. The latter, however, is not intended to apply to such slow-working lenses as Zentmayer's or the Ross Portable Symmetrical.

Instantaneous Photography—always a marvellous thing to uninitiated persons, and of most absorbing interest to those practising the Art—has received a fresh impulse from the highly-sensitive Gelatine Plate. As just mentioned, the Rapid Aplanatic lenses—not originally intended for this class of work—have been found to answer admirably for some kinds of it. But they must be used with certain limitations, and it is owing to a lack of knowledge of this adaptability of lens to subject, that not a few beginners have experienced much disappointment in their early attempts at Instantaneous Photography. For instance, after making a number of successful exposures on landscapes and groups in the open air, the same lens would be mounted with a very quick-acting drop-shutter, and an attempt made, perhaps, to take the portrait of an infant in-doors. A moment's thought will show that even with

a very sensitive plate this is more than a lens not specially constructed for such work could be expected to do, and the same would apply to studies of restive animals of dark color. The actinic power of the light on a river-view with moving vessels, for example, or a street filled with people and vehicles, is immensely greater than that on a dark-colored animal taken near at hand, or than any in-door illumination, no matter how good. For work of this description, nothing but one of the quick-working Portrait Lenses will answer, while for marine and street subjects, a lens like the Euryscope or Rapid Rectilinear will generally answer very well.

Thus it will be seen that if a varied class of photographic work is to be attempted, the outfit of lenses will have to be varied and increased accordingly; and the more experienced the operator becomes, the more he will recognize the impracticability of doing justice to all kinds of subjects with a limited stock of lenses. Many of the European out-door photographers carry as many as seven or eight pairs of twin-lenses for stereoscopic work alone. Few amateurs will be willing to incur the expense of such a large stock of lenses—at least, in the beginning of their Photographic studies—and the outfit

alluded to at the head of the chapter will be found the most generally useful.

Lenses of different size, and made by different makers, of course have flanges of different size. As it is very inconvenient to carry a separate front panel for every lens, adapting rings should be applied, so that a lens may be removed from the camera and any other one immediately screwed into its place.

Success will largely depend upon a thorough knowledge of stops. As many beginners often find this matter difficult and confusing, a few words may be devoted to it here. Stops are used for improving the definition of the lens, and accomplish it by lengthening the oblique rays of light, whereby the field of the lens becomes flattened and sharpness at the edges of the plate secured, and by increasing the "depth of focus," by which near and distant objects are made equally sharp. The smaller the stop, the more perfectly are these great desiderata fulfilled; but, as the amount of light passing through the lens is thereby lessened, it will always be well to use as large a stop as is compatible with good general definition. No rule for the use of stops can be laid down, different lenses, even by the same maker, requiring different stops.

It has lately become the custom in photographic literature to express the size of the stop in terms of the focal length; as, *e. g.*, $F/_{11}$, $F/_{20}$, etc. The expression is a very convenient one, particularly where lenses of different character are to be compared. In the above examples, for instance, the diameter of the stop would be one-eleventh or one-twentieth of the focal length. The 11-inch Rapid Rectilinear Lens of Dallmeyer, when used with the stop marked ×, corresponds to $F/_{11}$, the focus of the lens being 11 inches and the diameter of the stop 1 inch.

Beginners are often much puzzled as to the use of the different stops and the exposures to be given with them.* As before stated, no exact rule can be laid down; but in comparing one stop with another, it should be borne in mind that the light admitted will be represented by the *squares of the diameters* of the stops, a stop of half an inch diameter requiring *four times* the exposure of one an inch in diameter. An

* Where there is great uncertainty as to the timing, the cap of the lens may be taken off and the shutter of the holder pulled out for an inch, and an exposure given. The shutter is then pulled out an inch farther, and another exposure made; and this plan is continued until the shutter has been pulled all the way out and the whole plate exposed. A record is kept, and the development will show which section of the plate was properly timed.

example may be given from Voigtländer's Euryscope. Assuming that an exposure of one second was right for the No. 1 (largest) stop, the exposures would increase as the stops diminished in size, as follows:

For the No. 2 Stop	. . . . .	$1\frac{1}{2}$ seconds.
" " 3 Stop	. . . . .	$2\frac{3}{4}$ seconds.
" " 4 Stop	. . . . .	6 seconds.
" " 5 Stop	. . . . .	12 seconds.
" " 6 Stop	. . . . .	26 seconds.

The above figures represent the exposures *theoretically* required. In practice, however, such a table would be of very little use, owing to the differences in subjects, variation of light, and a host of other conditions. It may serve, however, to give a general idea of the relations of the stops to each other.

Neither can a rule for focussing be given, but an inexperienced operator will do well to devote a little special study to this very important point before venturing out in the field. Let him, for example, put the camera upon the window-sill, and, having drawn up a stool, so as to sit comfortably with the eye at the level of the centre of the ground glass, cover his head and the back of the camera with a black cloth, and move the ground glass in and out until the image is tolerably distinct. This should be

done without a stop in the lens; or if he is working with a Non-Aplanatic lens, the largest fixed stop should be used. Under these conditions, it will not be possible to bring all parts of the image into equally sharp focus, but a point will be found at which the sharpness is tolerably well distributed over the entire plate. If an object lying in one plane, like the wall of a house, be selected, it will generally be found that the best effect is secured by not focussing directly in the centre of the field, for that would leave the edges more or less indistinct. A point an inch or more off the centre should be chosen, and the slight loss of sharpness at the centre which will then occur will be made up for when the stop is inserted. If a street in perspective be chosen, where the objects lie in different planes, a good effect will often be obtained by focussing directly on the centre, this being, of course, the most distant point. The focus then necessarily being thrown far back, it will generally be found to bring the nearer objects at the margins into pretty good definition. As before, this should be done without a stop in the lens, and that point sought for which will distribute the definition as evenly as possible.

These suggestions would hardly apply to

lenses when worked with the full opening for Instantaneous Photography. In these cases the point focussed upon will generally have to be at or near the centre of the field, leaving the margins to take care of themselves. If they seem to be very hazy and indistinct, the only resource will be to use a longer focus lens capable of covering a larger field.

As before suggested, for *bonâ fide* Instantaneous Photography, where great speed is necessary and difficult subjects taken, the Portrait Lens will be the proper form of instrument. If such a lens, however, be selected for the taking of portraits, the operator should be sure to obtain one of sufficiently long focus. Unless the pictures are to be of very small size, the effects given by small Portrait Lenses are most unsatisfactory, especially when the camera is brought close to the sitter, as the nearer parts of the figure are disproportionately magnified.

Cameras.—The models on which Photographic Cameras are made are so great in number that a description of them would be impossible. A purchaser will not be apt to go wrong in his selection if he first makes up his mind what class of work is to be done. This is important, because different departments of Photography require different cameras as well as lenses. All

things considered, the amateur will find such a camera as shown in Fig. 1 very useful, as it is light, portable and steady, and may have additions made to it, if required, for copying or other special purpose in-doors. A swing-back is indispensable if architecture is to be attempted. When used, the camera is tilted up until the whole of the building is included in the picture; the swing-back is then pushed in at the top until parallel with the plane of the building, and the sliding-panel carrying the lens in front raised as far as required. The back should be made to swing in both directions, so that when the camera is turned upright it can also be used. The swing-back will be useful for bringing different planes into good focus, as a few trials will show.

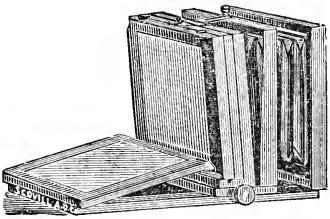

FIG. 1.

If a rack and pinion be on the camera—and this is by far the best arrangement for focussing—it must work with perfect evenness, and not be loose. The wood-work inside must be of a *dull* black color, and not reflect light. The camera must be *absolutely light-tight* (see directions, page 84), and the ground glass should

be hinged fast to the box and have a dark spot exactly in the centre, so as to aid in the proper selection of subject. It is scarcely necessary to say that the whole apparatus must be square and true; otherwise, sharp pictures will be an impossibility.

The Plate-Holder or **Dark Slide** for dry plates consists essentially of a frame with a movable end which carries a partition with a spring on each side, as seen in Fig. 4. Fig. 3 shows the holder with the doors for admission of light partly drawn out. The sensitive plates are slid in at the

FIG. 2.

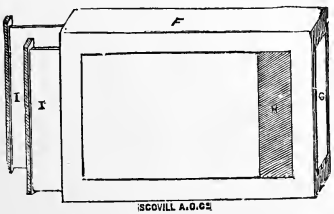

FIG. 3.

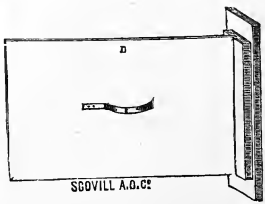

FIG. 4.

end with the *film-side outward*. The partition is slipped between them, and the springs force the plates into proper position. A test should always be made when buying a new camera, to be sure that the sensitive surface occupies the same plane as the surface of the ground glass, inasmuch as the sharpness of the picture depends upon it.

At least three double holders should accompany every landscape outfit. And, in order to prevent mistakes in exposure, a large distinct figure that can easily be seen in the dark room should be placed upon each side of each holder. The sliding-doors must be secured with a fastening of some kind, to prevent them from slipping out and fogging the plate. The movable end carrying the partition must likewise be firmly secured. The slit through which the sliding-door passes should always be examined, to see that no light enters when the door is withdrawn. The focussing-cloth (which, it may here be said, is a square yard of cotton velveteen) should always be thrown over the back of the camera and holder during the drawing out of the door preparatory to exposure. This simple hint will save many a plate from fog on the side nearest the slit.

The Holder for Wet Plates is made on the same principle, but carries only one plate.

The Tripod, if for landscape-work, should be portable, and *steady when set up*. The form shown in Fig. 5 is the preferable one. The triangular head should not be too small, so as to allow the upper sections of the legs to be well separated. It should be at least five feet high when set up. Rigidity will be found to

depend largely upon this. A good model for indoors is shown in Fig 6.

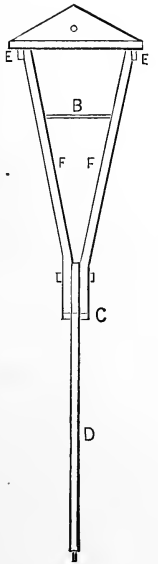

Fig. 5.

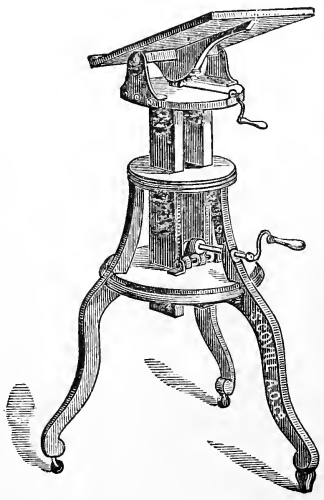

Fig. 6.

Focussing-Glasses are indispensable if sharp pictures are desired. They may be had at the stock-dealer's.

English apparatus is becoming more and more used by American amateurs. It is undoubtedly superior in model, lightness and finish. It happens sometimes, however, that the climate of this country is too severe for the wood-work, causing it to warp and crack. To

one who wishes for the very best obtainable outfit, the writer would advise an English Camera, Holders and Changing-Box. Any good mechanic would be able to make the few repairs that might be needed after some years' use.

When the Wet Collodion Process is worked in the field, or when the number of dry-plate holders is limited, a dark tent is necessary. Much ingenuity has been shown in the various modifications of this article; but many forms are really not tents, but boxes. The operator must be guided in his choice of a tent partly by his own personal peculiarities and partly by the size of plate to be worked. Small men, who can manipulate easily in a stooping or squatting attitude, will prefer the tent proper, on account of its portability and simplicity. A tripod considerably longer than the camera-stand, with a broad head, is first made, and then a covering of two thicknesses of black and two of yellow twilled muslin adapted, so that the tripod is entirely covered and an overlap of at least 15 inches left on the ground. One side is arranged as an entrance, likewise guarded by a safety-flap, and a window made by cutting out a square foot of the black muslin and adding additional yellow if necessary. Heavy

stones are laid on the ground-flap, to steady the whole when pitched.

Box-tents, as they are called, are very convenient to work in, and have the advantage of not requiring the apparatus and chemical bottles to be set on the ground. A wooden box of, say, $26 \times 18 \times 5$ inches is made to open and be held at a right angle by a suitably-arranged strut. The horizontal part, which serves as the operating-table, is screwed down to a short, strong tripod, and so held in working position, being removable for transport. A series of light wooden or wire supports are now so adapted to the box that they will serve to support the covering of some non-actinic material, which is made to cover the top and sides of the box, and is then continued on and passed over the operator's shoulders as he stands in front of the tent, being, in fact, like a bag without a bottom, its mouth being controlled by a draw-string. A pane of yellow glass is set in the back of the box, and a small metal tank with a rubber tube and clip is set on the top (or edge) of the box, outside, and supplies water very conveniently to the interior. A varnished iron dish of any required size serves as a sink, and is likewise furnished with a rubber escape-tube through

the bottom. Strong screw-eyes with cords and pegs, to fasten in the ground, are also adapted to different parts of the wood-work, so as to guard against an overthrow by a sudden squall of wind. When travelling, the box, being very capacious, will hold almost everything required except the camera, the tripod being folded and strapped to the outside. Fig. 7 represents Rouch's (of London) model.

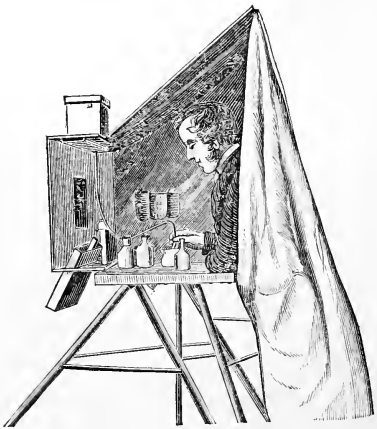

Fig. 7.

An ingenious contrivance suggested by Mr. F. Howard of London consists of a pyramidal bag (so to speak) of india-rubber cloth, which is hung to the screw-bolt of the ordinary camera-tripod and secured in its place by tapes tied to the legs. An opening is made in one side, and a yellow window adapted. A somewhat similar form, but extending quite to the ground, and with an opening to admit the upper part of the body, was very successfully used by Mr. Rau of Philadelphia during a

trip in Egypt. In Howard's model, sleeves are adapted, and a mask of yellow glass enables the operator to see the inside. As there is no bottom or table, properly speaking, pockets are arranged around the sides. This would serve very well for changing dry plates, and the inventor has even used it successfully for Wet Collodion.

An arrangement like a bag, made of dark cloth, with two sleeves, has been a favorite article in England for many years for changing dry plates, the plate-box and holder both being inserted, and the transfer of the plate from box to holder, or *vice versâ*, being effected by feeling. By applying the thumb-nail to each plate, it would scarcely be possible to mistake the film-side.

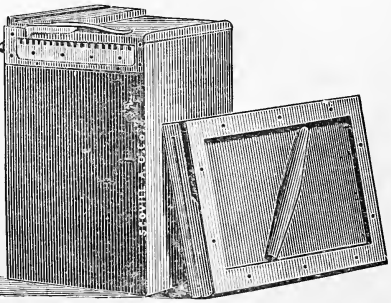

FIG. 8.

But (Fig. 8) a more convenient apparatus is the

Changing-Box.

This is a grooved light-tight box in which the sensitive plates are placed, and, when required, transferred to the plate-holder (seen at the side) by slipping the latter on to a brass guide, which

is screwed over a slot in the top of the box and is connected with a spring slide, which closes the slot as soon as the holder is removed from the guide. The bottom, or end, of the holder is furnished with a similar slot, which is closed by pushing down the back and fastening it in position by the bolt. The holder being slipped on (Fig. 9), both slots are opened, and by turning the whole affair upside-down, the sensitive plate passes through the slots into the holder by its own weight. The back of the holder is then buckled down (closing the slot), and the holder, with the plate inside, removed from the box, the slot in the box closing automatically, and thus protecting the other plates from light. The plate is returned to its place in the box, after exposure, in the same manner. The lid of the box slips in a groove, thus bringing the slot over any required plate. It also carries a pointer which corresponds to a row of figures on the box, so that no mistake is made in get-

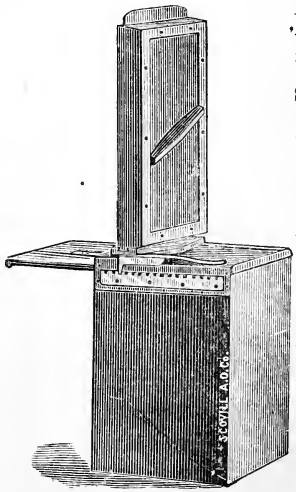

FIG. 9.

ting the desired plate. Changing-Boxes generally hold twelve plates.

The only objection to this most convenient piece of apparatus is that the glasses, unless they are cut with perfect accuracy, will not slide in the grooves. When plates are bought ready prepared, there is no resource in case of uneven size; and this, unfortunately, happens very often. But when the convenience of the photographer working out of doors is taken into account, together with the high prices paid for the plates, an objection such as this to an ingenious and excellent method of changing plates ought not to have any weight whatever. The writer, having used both changing-box and double holders, would certainly recommend the former in preference to the latter, and take some extra trouble to see that the plates fitted properly. The plate-makers complain that the glass comes to them irregularly cut; but when certain sizes are advertised by them on their price-lists, it is fair to expect that the plates shall be cut true to this size.

Instantaneous Shutters.—A large volume might be filled with a description of the various forms of shutter or drop in use at the present time. Nothing is better, however, than

the ordinary guillotine-drop (as it is termed), consisting of a grooved board fitting on the lens, with another thin board playing freely up and down in the grooves and perforated with an opening somewhat larger than the lens. This movable board may be supported by the finger (so that the solid wood below covers the lens) until the moment for expo-

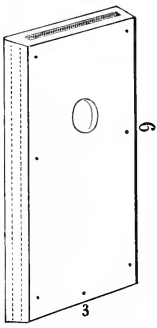

Fig. 10.

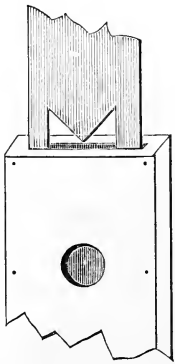

Fig. 11.

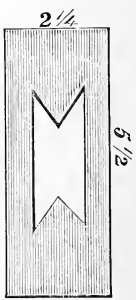

Fig. 12.

sure arrives; the finger being then withdrawn, the board falls by its own weight, and the exposure is made by the opening passing quickly in front of the lens. A pin, to stop the fall, completes the apparatus (Figs. 10, 11, 12).

By stretching an elastic band from one board to the other, the movement will be much accelerated; or if it be preferred to dispense with

the force of gravity entirely, a still stronger band may be applied and the whole affair arranged horizontally. If wood be the material employed, it must be thoroughly seasoned and every precaution taken against warping. To have a drop refuse to move at the critical moment, or stick fast when halfway down, is most annoying, and is very likely to happen when it is taken out into the hot sun for the first time. It is well to make the whole apparatus as light as possible, for the jar caused by the sudden stoppage of the sliding-part may injure the lens; and if a catch-trigger be preferred to the finger for starting it, care must be taken that it moves with *perfect ease;* otherwise, the camera will be disturbed and the picture have double outlines.

No description need be attempted here of the various forms of double shutter. It may be said, however, that, although very rapid in action, they expose the middle of the plate more than the edges. So does the ordinary drop unless the opening be made longer at the sides than in the middle. (See Fig. 12.) This, however, is a complete cure for the difficulty.

Fitting up the Dark Room.—Any room that can be made *perfectly dark* will answer the pur-

pose. The ruby lantern (page 86) may be used to give the necessary light to work by; or if daylight be preferred, a hole may be cut in the window-shutter and a double thickness of ruby- or orange-colored glass fitted in. If Gelatine Emulsions are to be prepared, the light must be reduced to the minimum; but when plates are to be developed only, orange light in fair amount will answer, and be preferable to the other, which has a distressing effect on the eyesight. The writer has recently seen the developing-room of a prominent photographic establishment in Philadelphia, where orange light was used in such quantity that the finest print of a newspaper could be read with ease on a rainy day. It is only fair to mention, however, that in this case it was an *inside* room whose window was quite a distance back of the one opening directly to the sky. Nevertheless, the light in the dark room rendered all manipulations perfectly easy—a fact that will be the better appreciated, as it is now known that even the purest ruby light will act upon a Gelatine Plate in a comparatively short time. If plates of such an unfortunate degree of rapidity have to be used, it will be necessary to keep the developing-pan covered.

A capacious sink and water-tap are, of course,

indispensable in a well-arranged dark room, as are also shelves or tables to hold the various bottles. A gas-jet is convenient for printing transparent positives; though, if the ruby lantern is used, this may be dispensed with. A light-tight closet in which a plate may be laid, so as to allow the operator to go out if suddenly called, will be a great convenience, besides serving as a drying-closet for preparing plates. Good ventilation is very important; and if Collodion is used, it is a matter of the very greatest necessity, grave injury to the general health being the penalty if neglected.*

The professional photographer or those who work on a large scale, will fit up their dark rooms with every care, knowing that no amount of work can be done in comfort without all conveniences ready at hand. The amateur, however, is often confronted with a serious problem as regards a dark room, the more elaborate arrangements just referred to being out of the question for him. For these, an ordinary bath-room may serve a good purpose, provided that there are sufficient means of darkening it—at least, when required for development of Gelatine Plates or the manipulation of Wet Collodion *during daytime.* It will be well to provide a

* See Chapter V.

large shallow pan with a rubber escape-tube fitting into the drain-pipe of the tub; otherwise, the solutions will soon ruin the metal-work. A few extra shelves or a firm table will also be required, and a yard or two of rubber cloth to protect them from corrosive fluids, as well as a good-sized sponge, with which the whole should be well washed off after the work is over. Considering the danger of introducing such articles as Oxalate of Potash and Bichloride of Mercury into any part of a household other than a room specially devoted to chemical pursuits, these precautions will not be deemed excessive.

Every amateur will fit up his room, temporary or permanent, to suit his own peculiarities. It may be well to remind him, however, that the arrangement of the non-actinic light will have much to do with a successful result. It should be admitted close to the sink and on a level with the tap, or, at least, not higher than the waist of the operator as he stands. This serves to illuminate the sink and bottles, and at the same time aids in the examination of the negative by transmitted light; while if the operator prefers to sit down during the development and washing, it will still be at the proper height. If the arrangement of the

spigots is not convenient, rubber tubes may be slipped over their mouths, and the water thus conducted to any required position.

A beginner in Photography will be apt to crowd into the dark room many articles that are of no use there and only create confusion, or sometimes serious blunders. No operations should be performed in the dark room that can be done outside, where there is plenty of light, and during the actual photographic manipulations, the working-space around the sink should be kept as clear as possible, and frequently sponged off dry, so as to prevent drops of dirty fluid from falling off from the bottom of a graduated measure into freshly-made solutions, etc. An india-rubber squeegee will be found very useful for this purpose.

CHAPTER III.

EMULSIONS.

The first experiments with Emulsions applied to Photography are generally accredited to Messrs. Sayce and Bolton of Liverpool, England, and to the latter gentleman we owe the valuable and beautiful *Washed Emulsion Process.*

Perhaps the best definition of the word "Emulsion" is given by saying that it is a fluid consisting of a finely-divided insoluble substance suspended in a colloid vehicle. Photographic Emulsions consist of Bromide of Silver suspended in Collodion or Gelatine. Chloride of Silver has also been employed, but its inferior sensitiveness precludes its being used in the camera, and renders it serviceable only for opalotypes or transparent glass positives. Iodide of Silver is sometimes added to Gelatino-Bromide Emulsions, but it is not fitted to be used alone in this manner.

An Emulsion of Collodio-Bromide of Silver may easily be prepared by first making up a sufficient quantity of Collodion salted with the Bro-

mides of Cadmium and Ammonium, either alone or mixed, and then adding a carefully-calculated quantity of Nitrate of Silver dissolved in boiling Alcohol. This immediately forms Bromide of Silver in the Collodion; but the process is not finished when the Silver is added. It is only after the expiration of some hours or days that reaction fully takes place between the salts, as may be seen by the thick, creamy appearance of the Emulsion after standing for a time, contrasted with its thin opalescence when the Silver is first added. Bromide of Silver will be found to form much more rapidly if an excess of Nitrate of Silver be present than if the other salts mentioned are in excess; but if an Emulsion containing an excess of the Silver salt be allowed to stand longer than a certain time, depending upon heat of weather, thickness of Collodion, etc., fog sets in. The Emulsion will be found to gain in sensitiveness *pari passu* with the increase in creamy opacity up to a certain point, beyond which thinness of image and general fog under the Developer are manifested. In order to take advantage of the more rapid formation of the Silver Bromide in presence of an excess of soluble Nitrate, it is customary, among those who manufacture Emulsions, to reserve a portion of the bromized Col-

Iodion to be added to the principal bulk of the Emulsion after this has been allowed to react with the full quantity of Silver salt for the necessary time, any excess of Silver being, of course, neutralized by the fresh addition. No little care and accuracy are required in calculating the quantities of the different salts, an excess of the soluble Bromides causing great insensitiveness and other troubles, just as an excess of the Silver salt causes fog unless properly restrained by the addition of a mineral acid.

The operations of taking a negative with Collodio-Bromide of Silver Emulsion are very simple and easy. A clean good piece of glass is coated with the Emulsion just as if it were Collodion, and, the proper setting-time having elapsed, the plate is dipped into a vessel of water and worked about until the water flows smoothly over the film; it is then dipped into a preservative solution, such as Tannin—about 15 grains to the ounce of water—and reared up to dry. After exposure, it is developed with a strong Alkaline developer and fixed with Hyposulphite of Soda.

The washing of the coated plate performs here something more than the mere removal of the Ether and Alcohol. It must not be

forgotten that there is always more or less free soluble Bromide in the Emulsion besides the Nitrates of Ammonium and Cadmium, which are formed by the double decomposition of the Silver and the haloid salts. Unless these matters were removed from the film, they would crystallize there when the plate dried and make the film uneven and useless. Considering that each coated plate, when washed, presented a thin film of Emulsion to the water, it was but a short step from the Collodio-Bromide Process, as just described, to the Washed Emulsion Process, when the Emulsion in bulk was allowed to set in a shallow pan and afterward washed with water, to remove all soluble matters. The Emulsion, however, being thus reduced to the form of a solid pellicle similar to the film of the washed plate, had to be redissolved in a mixture of Ether and Alcohol, in order to render it workable. This added to the cost of the process very materially, the first batch of Ethereo-alcoholic solvents necessarily going to waste. Still, in spite of this fact, the great convenience of being able to prepare plates by merely pouring the Emulsion over the glass, and, immediately upon drying, having plates ready for exposure, as well as the exquisitely clean working of the washed Emul-

sion, which seemed to yield up innumerable failures and defects to the water, led to such extensive adoption of the process, particularly by out-door photographers, that it is safe to say that nothing but the more highly sensitive Gelatino-Bromide could ever have superseded it; and, in fact, it is still a favorite process with many, its cost not equalling that of Gelatine plates when bought ready made.

Although few, perhaps, of those to whom this little work is addressed, will care to undertake the preparation of Emulsions, yet the writer has felt that he might very properly introduce here a formula for Washed Collodion Emulsion which was given to him by Mr. Bolton in August, 1877, and the excellence of which he has verified by experiments of his own. The writer is also aware that, in spite of the almost universal employment of ready-made Gelatine plates for out-door work at the present time, numerous demands have been made for Washed Emulsion, and that there are many who would gladly avail themselves of it if it was to be obtained commercially. The directions here given must necessarily be brief; but those who wish to become thoroughly familiar with this excellent process will find the literature of the subject in abundance

in the Photographic Periodicals, particularly between the years 1874–1878.

To prepare the Salted Collodion take of

Ether	36 ounces.
Alcohol	24 ounces.
Negative Cotton	480 grains.
Bromide of Cadmium	525 grains.
Bromide of Ammonium	315 grains.

Triturate the salts together in a mortar until they become liquefied; then add the Alcohol, and filter. Finally add the Ether and Cotton, and shake till dissolved. A second filtration is advisable.

The sensitizing is carried out as follows:

Take of the above,

Salted Collodion	18 ounces.
Nitrate of Silver	350 grains.
Nitric Acid	5 miniums.

Add the Nitric Acid to the Collodion. Pulverize the Silver, and dissolve it in just enough boiling Alcohol to take it up, adding, if necessary, *a very few drops* of water. Shake thoroughly, pouring in the Silver a little at a time, and then allow the whole to rest for twenty-four hours. Finally add 2 ounces more of the Salted Collodion.

This Emulsion should be tested, to be sure that it does not fog. If it does, correct with a small amount of Bromide or Chloride of Cop-

per. It may now either be precipitated by pouring the whole *slowly* into a 10-grain solution of Tannin (using at least four times the bulk of the Tannin Solution), or, preferably, by pouring the whole into a flat dish and allowing the Ether and Alcohol to evaporate until a leathery flexible mass is produced. This is to be cut into small pieces with a silver fork and washed in a dozen or more changes of water, and finally dried on blotting-paper. The dried mass can now either be immediately redissolved in a mixture of equal parts of Ether and Alcohol, in the proportion of 18 grains to the ounce, or it may be kept in a well-closed vessel in a dark place for any length of time. It is scarcely worth while to add that all the operations subsequent to the mixing of the Salted Collodion must be done in the dark room.

As before stated, the sensitiveness of Collodion Emulsion, either washed or unwashed, depends upon the time allowed for the reaction of the salts. In spite of much effort, it was not found practicable to obtain a sensitiveness of more than about half that of Wet Collodion if clean results were expected. Experiments now began to be made with Bromide of Silver in other vehicles than Collodion, and it was

soon found that *Gelatine* increased the sensitiveness of the Silver haloid in a most marked manner, and that, too, without superinducing fog or other causes of failure—at least, those of such a character as were already known in the working of Collodion Emulsion. Failures, indeed, were encountered, and much study was required to overcome them. Frilling, as it is termed, or the unequal expansion of the Gelatine film during the development and after-processes, was at one time a very great source of annoyance. It was finally overcome by adding a little Chrome Alum to the Gelatine Emulsion before the plates were coated. This confers sufficient hardness upon the film to make it resist the washing very well indeed. Samples of Gelatine which had become more or less decomposed during manufacture, or which contained undue amounts of blood, fat, or other impurities, produced characteristic defects soon recognized and overcome.

When we compare the two fluids under consideration—namely, Collodion and Gelatine in solution—we find the most marked differences in their properties and behavior. In order that homogeneous films may be prepared with a Collodion Emulsion, all that is necessary is

to balance the glass plate with the fingers or with a pneumatic plate-holder, and to pour the Emulsion freely on at one end, raising the glass, so as to make the liquid cover its whole surface evenly, and finally guiding it off at an opposite corner, meanwhile rocking the glass edgewise to and fro, so as to prevent the formation of crapy parallel lines. The spirituous solvents rapidly evaporate, and the process is soon ended. But with Gelatine, matters are very different. Here the solvent is entirely aqueous, and a much longer time is required before the film will bear any alteration in the position of the glass. The Emulsion does not flow on the glass with as much ease as Collodion, and frequently has to be guided with a glass rod. Pouring off at the corner, as in the case of Collodion, is inadmissible, for if this be done, the film becomes uneven, and at times the whole of the Gelatine will slide off the plate. A measured quantity of Emulsion should be poured on the plate, and after being spread out to the corners it is laid on a perfectly level glass or marble slab and left there until the Gelatine has firmly set, when it may be removed to the drying-box, which must have a free current of dry, cool air supplied by some mechanical

means. Several hours are generally required for the drying.

Numerous formulæ have been proposed for the preparation of Gelatino-Bromide Emulsion. The general principle of the formation of the silver haloid is much the same as in Collodion Emulsion. Still, as a whole, the process offers marked differences. Three divisions may be made of the various processes of Emulsion making: (1) Digestion; (2) Boiling; (3) Cold Emulsification (generally requiring Ammonia in some form).

In *Digestion*, the Gelatine, having been dissolved in water containing the necessary quantity of Soluble Bromide, is mixed with the Nitrate of Silver dissolved in water, and the whole set aside in a warm place until a sufficient degree of "ripeness" has been attained. It is then allowed to set, and, having been cut up into small pieces, is well washed in cold water, to remove all soluble matters, after which it may be remelted and filtered through chamois-skin preparatory to coating the plates.

In the *Boiling Process*, a limited amount of the Gelatine is dissolved in water, and, the salts having been added, the vessel is placed in boiling water and allowed to remain there

for a specified time—seldom more than a couple of hours. The highly-sensitive variety of Silver Bromide is rapidly formed under the influence of heat, and at the expiration of the boiling, the remainder of the Gelatine is added, and the subsequent steps of setting, washing, remelting, etc., followed out, as in the first instance.

In the *Process of Cold Emulsification*, the Silver is generally added in the form of Ammonio-Nitrate, made by adding Ammonia to a solution of the Nitrate until the brown Oxide is redissolved. The temperature is not higher than actually required to keep the Gelatine fluid, and the length of time allowed before setting is made to vary with the degree of sensitiveness required. The other steps in the process are the same as before described.

To succeed well in the preparation of Gelatino-Bromide Emulsion requires care and accuracy in combining the different materials, a properly-arranged non-actinic room, with conveniences for heating and washing, and a considerable knowledge of the general chemistry of Emulsion Photography, and of Gelatine in particular. Just as the good qualities of a Collodion Emulsion will depend largely on the character of Soluble Cotton used, so

will the Gelatine Emulsion upon the Gelatine. It is not to be wondered at, therefore, that not merely amateurs, but the greater number of professional photographers also, do not attempt the preparation of the Emulsion or plates. The Gelatino-Bromide Process is essentially one which must be conducted on the large scale if uniformity of results be aimed at. An amateur experimenting with small batches of Emulsion might, indeed, secure good results, but he could never count upon his plates in regard to uniform sensitiveness as he could upon those obtained from a manufacturer of reputation, who by long experience would know what allowances to make for the fluctuations in the quality of Gelatine and the various atmospheric changes, which cannot fail to affect so delicate and complex a substance as Gelatine Emulsion. Nevertheless, as there are some who might like to make an experiment for their own understanding of the process, the following formula is given, after Vogel:

Take of

Distilled Water	3½ ounces.
Bromide of Ammonium	185 grains.
Gelatine	31 grains.

After the Gelatine has become well swollen,

put the vessel into warm water till the ingredients are dissolved; then, *by ruby light*, add 308 grains of Nitrate of Silver previously dissolved in 25 fluid drachms of water and warmed. Now add 4 drops of Glacial Acetic Acid, and set the whole in a kettle of boiling water, where it may be left from a quarter of an hour to two hours, depending upon the sensitiveness required. The mixture is to be frequently stirred, and at the expiration of the boiling 123 grains additional Gelatine previously swollen in *cold water* and drained are to be added to the Emulsion and well stirred about till dissolved.

The vessel containing the Emulsion is now to be stood in ice-water until the whole mass has finely jellied, or set. It is then turned out into a piece of coarse canvas with large meshes and forcibly squeezed through with the hand, so as to divide up the total bulk into small pieces, which must be washed in half a dozen or more changes of water. After washing, the Emulsion must be drained on a clean cloth and remelted by a gentle heat. It may now be filtered through some suitable medium and used immediately for coating plates, observing the precautions before alluded to.

CHAPTER IV.

DEVELOPERS.

The term *Developer* is applied by the photographer to the liquid used to render visible the latent image formed on the sensitive film by exposure to light.

Developers as now used may be classed in four divisions as follows:

1. The Iron Developer for Wet Collodion Plates.
2. The Alkaline Developer for Dry Plates in general.
3. The Acid Pyrogallic Acid Developer.
4. The Ferrous Oxalate Developer for Gelatino-Bromide Plates only.

The Iron Developer for Wet Collodion Plates consists of a solution of Sulphate of Iron (Ferrous Sulphate) in water of from 10 to 35 grains per ounce and containing from 15 to 30 drops of Glacial Acetic Acid or an equivalent proportion of the weaker commercial acid, No. 8. Much space might be occupied with the mention of the various substances which have been

added to this form of developer by different operators in the hope of obtaining some peculiar advantage. But it is very sure that the simple form of the developer as given, is the best, the skill of the operator being shown in the manner in which he varies the proportions of the different ingredients to suit the particular work at hand, more of the Iron salt and less acid being required in cold weather and for very dark subjects, and *vice versâ*. A very efficient and useful substitute for the Acetic Acid, or at least a part of it, is found in the Collo Restrainer (page 161). Where very large quantities of developer are used, a considerable pecuniary saving may be thus effected. Alcohol, seldom omitted in the formulæ of some eminent authorities, should be regarded only as a *mechanical* addition, and as being undesirable and useless if the developer can be made to cover the plate evenly without it.

The Alkaline Developer is quite different from the foregoing, and consists of a weak solution of Pyrogallic Acid (one or two grains per ounce) with a small quantity of some alkali, such as Aqua Ammoniæ, Carbonate of Ammonia, or Carbonate of Soda, and a trace of some soluble alkaline bromide. This mixed solution possesses strong affinities for Oxygen

and for Halogens, and has the power of reducing the Sub Bromide of Silver of which the latent image is composed to metallic Silver. It will be observed that this developer is intended for films consisting either in part or wholly of Bromide of Silver. Iodide of Silver, as found in many ordinary dry plates prepared by the older methods, will also be acted on to a certain extent by the Alkaline Developer, but not so markedly as the Bromide. Vogel of Berlin draws a distinction between the Acid Pyrogallic or ordinary Iron Developer for Wet Collodion, and the Alkaline Pyrogallic Developer, by calling the two former *Physical* developers, and the latter (alkaline) *Chemical.* Although such nomenclature can hardly be called correct, still it is convenient and renders the action of the developers when compared easy to understand; the picture being largely *built up*, so to speak, by metallic Silver precipitated on the film by the Iron Salt or Pyrogallic Acid from the free Nitrate of Silver either present on the film (in the Wet Collodion plate) or purposely added (in development with Acid Pyrogallic Acid), thus constituting a Physical development as contrasted to the more essentially Chemical development with the Alkaline Developer, which effects reduction in the film without the presence of

free Nitrate of Silver; in fact if the Nitrate be present even in very minute quantity, it will cause turbidity of the developer and instant fogging of the picture.

Many substances have also been proposed for addition to this developer as in the case of the Iron Developer; Glycerine, Sugar, and Glucose among others. All that can be said of them is that they do not seem to injure the working power of the solution, while it is certain that they have no value whatever in increasing its power or general usefulness. A skilful operator will have ample opportunity of applying his knowledge when working with Alkaline Pyro. It admits of even more modification in the proportions of its component parts than the Iron Developer. It will be found that an increase of the Pyrogallic Acid confers increased density or opacity of image. An increase of the Alkali stimulates the whole process of development, forcing detail out of the dark or undertimed parts of the plate. An increase of the Soluble Bromide acts as a check upon the development, its restraining action being directed rather to the Alkali than to the Pyro. For example, in the case of a somewhat *overtimed* plate, the proper modification will be to diminish the Alkali, keeping

the full quantity of Pyro and Bromide so as to retard the development sufficiently to allow the Pyro to do its full work in producing density, the shadows meanwhile being kept clear by the full quantum of Bromide. An *undertimed* plate will require a much stronger Alkali and very little if indeed any Bromide, the Pyro being added in small amount at first and gradually increased as the development proceeds, so as not to allow the high lights* to become too dense at the expense of the half tones and shadows. An important practical point in the use of the Alkaline Developer is, that a *strong alkaline solution applied to the film at the beginning of the development will accomplish more than it would if applied toward the end or after weaker solutions had been tried.* For instance, if the plate was known to be materially undertimed, the proper plan would be to apply the stronger developer at first, and not attempt to coax the image out with weaker solutions. The mixed developer soon loses its strength if allowed to stand, absorbing Oxygen from the air and becoming brown and finally black in color.

* The "lights" of the negative are *its dark parts—i. e.* the lights as existing in nature and in the photographic positive, which is thus a negative of a negative.

The most convenient plan is to keep stock solutions of Carbonate of Ammonia and Bromide of Potassium which may be added to a given quantity of water in proper amount, and then a few grains of Pyrogallic Acid stirred in just before applying to the plate.

The acid Pyrogallic Acid Developer was used exclusively in the early days of the Wet Collodion Process when the Collodion contained Iodides only, but simultaneously with the introduction of Bromides in the Collodion, Sulphate of Iron began to be used for the purpose and very soon displaced the Pyro. The acid Pyro. developer is now used for the after-intensification of negatives both on Gelatine and Collodion, and for the development of ordinary Dry Plates made in the bath, where it is generally applied after the Alkaline Developer has brought out the details of the picture, to give the required density. *Thorough washing of the plate before it is poured on is always indispensable.* A suitable form of this developer consists of two or three grains of dry Pyrogallic Acid to the ounce of water with the addition of a drachm of Acetic Acid No. 8, or a grain or two of Citric Acid. A few drops of a 20-grain solution of Nitrate of Silver are added immediately before application to the film.

A much used form of developer which seemed to make its appearance simultaneously with Gelatine Plates is the Ferrous Oxalate Developer. It is entirely different in composition and in action from any of the others, and should be closely and carefully studied. The student will be struck with the curious fact, that the Ferrous Oxalate, which is the developing agent proper, is quite insoluble in water, and requires a strong solution of Oxalate of Potash to render it soluble so that it can be made use of for development. This developer may be prepared in two ways. If solutions of Oxalic Acid and of Sulphate of Iron (Ferrous Sulphate) be mixed together, a yellow precipitate of Ferrous Oxalate is deposited. This may be washed in several changes of water and finally thrown into a saturated solution of Oxalate of Potash, when after the lapse of some few moments and thorough stirring, it will redissolve, forming a liquid of a light cherry red color, which becomes darker by exposure to the air, and finally deposits a sediment, in which condition it is no longer fit for use.

A much more ready mode of preparing the developer, however, is to keep stock solutions of Oxalate of Potash made slightly acid with

Citric or Oxalic Acid, and Sulphate of Iron of the strength of 100 grains to the ounce, with about a drop of C. P. Sulphuric Acid added to each ounce to prevent decomposition by the action of the atmosphere. The Iron Solution is best kept in small bottles filled until the liquid nearly touches the cork, so as to exclude air. The Oxalate Solution requires no such precaution, being remarkably stable. It is the practice of some operators to add a certain amount of Bromide of Potassium to the stock Oxalate, but it will be found more convenient to keep the Bromide separate in say a 20-grain solution, which can be added to the mixed developer as required. The Oxalate may be in the form of a saturated solution. When required for use it can be diluted to the working strength given on page 87. In this case the proportion of 100-grain Iron Solution added thereto must not exceed 1 : 3; but if a stronger developer be needed, the *saturated* solution of Oxalate can be added, and then more Iron.

Owing to the fact that the proportion of Iron to Oxalate cannot pass the prescribed limit, from the separation of Ferri Oxalate which then takes place, it is clear that this form of developer, while giving excellent re-

sults on plates *that have received the proper exposure,* is not susceptible of modification in the case of over or undertiming like the other forms previously treated of. While nothing can exceed the beauty of a good Gelatine negative developed with Ferrous Oxalate, it is most imperative that the exposure be given with special reference to the developer, inasmuch as little can be effected after the development has once started. There is a great diversity of opinion as to the merits of the Ferrous Oxalate Developer compared to Alkaline Pyrogallic Acid for Gelatine Plates. Without wishing to enter into the controversy farther than is necessary, the writer holds to the opinion that Alkaline Pyro. is the preferable developer for all films consisting of pure Bromide of Silver, and prefers to use it for Gelatine Plates whenever it is possible to do so. The reason why this latter fell into disfavor with many operators was because the plates frequently showed a universal yellow stain or discoloration that defied all attempts at removal. In all cases where this staining appeared, the beauty and good printing qualities of the negative were sadly marred, and frequently the plates were utterly ruined. Ferrous Oxalate, on the other hand, never failed in this man-

ner, and this was undoubtedly the chief reason why it so rapidly came into use. It would be very natural to ascribe the discoloration directly to the developer, but the writer has always believed that it was caused by some as yet unknown condition of the Gelatine Emulsion, particularly when of the very sensitive kinds. He always prefers Pyro. development for Gelatine Plates, on account of the ease with which the solution may be modified to suit plates having received different exposures, while, as before stated, with Ferrous Oxalate this can only be done to a very limited degree; and that it is by no means an easy matter to give precisely the right exposures, particularly in out-door work where lenses of different angle and rapidity have to be used in rotation, any one who has had experience in this direction will testify.

Again, where large quantities of this developer have to be used, it will be found decidedly more expensive than Alkaline Pyro. By rights, a fresh portion of developer ought to be used for each plate, though it is possible at times to use the same developer repeatedly, particularly if it has been diluted with water, as recommended by Mr. Carbutt for transparent positives. But whenever the full power

of the developer is sought after, it will soon throw down the red sandy precipitate of Ferric Oxalate, and when this occurs, the plate must be immediately removed and the dish and the film well washed before applying fresh developer.

Whenever considerable quantities of developer are used, it will be well worth while to save that which has been used, collecting it in some large vessel that will bear heat, and at any convenient time to work it over in the following manner: the vessel is to be put in a warm place and kept there until it is about as hot as the hand will bear. The solution should be well stirred up with a glass rod, so as to redissolve at least the greater portion of the green crystals of Potassio-ferric Oxalate. A strong solution of Caustic Potash in hot water is then prepared and added to the spent developer until no further precipitate of red Oxide of Iron is thrown down. The whole is now to be filtered through paper, and enough Oxalic Acid added to restore the slight acidity which is always required in the Stock solution, as already mentioned. Finally, the solution may either be evaporated down to the saturation point, or a sufficient quantity of fresh Oxalate of Potash added, to saturate the added liquid.

Those who handle these chemicals for the first time, will remember that Oxalic Acid and its salt, the Oxalate of Potash, are violent poisons, and that Caustic Potash is one of the most powerful known escharotics. The greatest care must be taken not to allow drops of a solution of the latter to remain on the skin; they should be instantly washed off and a little weak Acetic Acid applied. The proper antidote for Oxalic Acid and its salts when swallowed is Lime in some of its forms—say, Chalk or Whitewash.

The remarks made in the preceding chapter on the differences between the Gelatine and the Collodion film, must be borne in mind in making choice of a developer. The quantity of Ammonia that would be just right for a Gelatine Plate would utterly ruin a Collodion film, unless the latter was much undertimed, and even then it would be dangerous to apply it at the full strength. The quantity of Pyro. used is not of so much importance, except that an excess in either case produces too much density. Ferrous Oxalate is not suitable for Collodion films.

CHAPTER V.

WET COLLODION.

Although Dry Plate Photography, particularly the Gelatino Bromide Process is the all absorbing topic in photographic literature of the present day, nevertheless the Wet Collodion Process is still largely used, and will continue so to be, if for no other reason than because it can be worked more economically than Gelatine, at least when the plates are bought ready made, as they are by the large majority of photographers.

Not only on its own account, but also as the basis of many excellent Dry Plate Processes, it could not be omitted from a manual like this, although it cannot be very fully treated.

The great point of difference between this process and all others treated of in this work is, that the plates when prepared must be exposed and developed within a few minutes of their preparation. From the time when the process could fairly be said to claim an exist-

ence, this necessity was felt to be a very great inconvenience, and led to the attempt to preserve the plates, so that exposure following immediately upon preparation might not be required. Success crowned these efforts in many cases, but always, it must be confessed, at the sacrifice of some of those qualities that rendered the Wet Collodion plate so justly popular. The chief loss was in sensitiveness, as will be seen in the chapter on Bath Dry Plates, and it may be said here that in all those processes the initiatory steps, up to the removal of the plates from the Silver Bath, are identical with the preparation of a Wet Collodion Plate as used in the studio or in the field.

As all the manipulations then must follow each other in quick succession, it scarcely need be said that the dark room must be as near as possible to the subject; in Landscape Photography this is provided for by a portable tent, as described in the chapter on Apparatus. For in-door work, any room or large closet where a sink and water supply can be introduced, will answer the purposes of a dark room. Light may either be admitted from the outside through a small pane of deep orange-colored glass, or a gas flame, oil lamp,

or several candles may be used after surrounding them with glass of the said color. All white light must be rigidly excluded. Means of ventilation should always be provided, the continued inhalation of the fumes of Ether having a depressing effect upon the nervous system.

Collodion is a solution of photographic gun cotton or Pyroxyline in a mixture of Ether and Alcohol. The materials for making it may either be bought from the stock dealers, or the Collodion may be had ready made. Different kinds of Pyroxylines or "cottons," as they are called, are always to be had. A good sample should be nearly white, not too tough in texture, free from acid, and, when burnt, leave but little ash. It is highly inflammable.

Ether for Collodion should have no acid reaction and be as free from water as possible. Alcohol should be 95 per cent. strong, and free from Methyl and Fusel Oil. The Iodides and Bromides kept by the principal dealers are generally reliable.

To make Plain Collodion, put into a *clean dry* bottle, four ounces of Ether and two and a half ounces of Alcohol. To this add forty-eight grains of a suitable Cotton.

It must here be observed that different Cottons give Collodions of different thicknesses. If the above proportions (when iodized) give too thin a Collodion, more Cotton must be added; if too thick, a mixture of Ether and Alcohol in the same proportion may be used to thin it down.

The following Iodizing Solution is made up and kept in a separate bottle:

Alcohol	1½ ounces.
Iodide of Cadmium	28 grains.
Bromide of Cadmium	10 grains.
Iodide of Ammonium	20 grains.
Bromide of Ammonium	7 grains.
Iodine	1 grain.

A few days before use, the Collodion is salted by adding to every 6½ drachms of Plain Collodion 1½ drachms of the Iodizer.

The Collodion and Iodizer are both well filtered; the Iodizer will run through ordinary filtering paper, but the Collodion being viscous, must be passed through either cotton, sponge, or washed tow, and then allowed to settle until perfectly bright and clear.

The Bath.

The finest qualities of crystallized Nitrate of Silver as supplied by manufacturing chemists of reputation, will be found when dissolved in

distilled water, to give a nearly neutral solution or at least one very faintly alkaline. With a certain class of collodions it might be possible to use such a solution for Negative Bath purposes without the addition of acid. But it cannot be too strongly urged that Nitric Acid should invariably be added to the Negative Bath, and that too in amount sufficient to give a decided response from blue litmus paper. Half a fluid drachm to two quarts of Bath would be none too much to begin with, and some samples of Nitrate of Silver will require much more if clean results are desired. Such samples on close examination show a small and more or less ill formed crystalline structure and have a greyish opacity when contrasted with the clean transparent tables of the pure salt.

The purity of the water used for the Negative Bath must be no less carefully attended to than that of the Silver salt. Any good soft river or spring water after being filtered will usually answer, but an undue amount of foreign salts such as Carbonates, Sulphates, and particularly Chlorides will be injurious both by causing loss of Silver and by the peculiar effect produced upon the sensitive film. An extreme thinness of the image, and a granular-

ity of the film, or at times fogging, may be traced to the presence of these inorganic matters. Distilled water of course is free from these impurities, but if obtained from certain sources where no guarantee of its good quality can be given, it may be just as bad as the before mentioned. For instance, the condensed water from steam pipes and boilers would contain oily matters, and probably Iron in some form, and a bath made from such water could never be depended upon. Rain water, if caught in clean china or wooden vessels, answers well, and the same may be said of clean melted ice or snow, but not of the drip from the roofs of houses where dust and other impurities are always present. Hard water from wells might be rendered serviceable by adding a pinch of Carbonate of Soda to every half gallon, and then boiling thoroughly. This would throw down the Lime Salts and drive off any excess of Carbonic Acid, leaving the water slightly alkaline after filtration, which would do no harm. Whenever the purity of the water is suspected, it will be well to add a little Bicarbonate of soda to the solution until a decided yellow precipitate of Carbonate of Silver is visible, and then to stand the bottle in full sunlight for at least a day, afterward

filtering out the black residue and acidifying with Nitric Acid as mentioned above. The Bath so prepared may be deemed free from Carbonates, Chlorides, and at least a large amount of such organic matters as are contained in ordinary water.

Supposing a Negative Bath to be made with a good quality of Nitrate of Silver, pure water, and containing a sufficient quantity of Nitric Acid to ensure clean results, it may be worked continuously until the Alcohol from the plates has accumulated to such an amount that the developer will no longer flow evenly over the film. The operator will now have to choose between adding Alcohol to the developer so as make it flow smoothly, the working over of the Bath, or the preparation of a new one. When photographing away from home with Wet Collodion, it is often a very risky matter to prepare a new Bath from water of which doubtless nothing is known, and with perhaps no facilities at hand for making proper tests. Under such circumstances it would be preferable to continue using the old Bath as long as the addition of spirit to the developer made it practicable to do so, or as long as there were no signs of fogging.

The best vessel in which to keep the Bath is

a glass trough with a tight fitting top of *pure* india-rubber, known as virgin gum, not the white vulcanized rubber as usually supplied, for the Sulphur in this latter renders it utterly useless for the purpose. The ebonite or vulcanite troughs sold by the stock dealers will answer if a pure rubber top is adapted and the trough filled with weak Nitric Acid for a few hours and then well washed out before pouring in the Bath. Even with these precautions, it will not be safe to leave the solution in any such vessels for more than a few hours, as they are sure to act injuriously upon the delicate Silver Solution before very long. A cheap and very good substitute for glass or vulcanite, is wood, well seasoned, and thoroughly soaked with Paraffine after the vessel is made, a hot iron being used to drive it in.

The glass used for photographic purposes must be of good quality, and cut accurately to the required size. The sharp edges must be removed by grinding on a soft stone, and a bath of weak Nitric Acid (one part to three of water) prepared, in which the glass is soaked for twelve hours. It is then well washed in water, rubbing off both surfaces with a sponge, coated on one side with the following substratum, and dried:

White of Egg	1 ounce.
Water	25 ounces.

Mix well together and filter through paper.

The Collodion is poured on and off the glass as described in the chapter on Emulsions, and when the lower corner has ceased to drip, and become tacky to the touch, it is dipped in the bath. The plate may be coated in daylight, but must be dipped in yellow light. An immersion of three or four minutes is enough, if the plate be moved up and down a few times by means of the dipper.

It is now ready for exposure, and is to be immediately after developed by applying

Sulphate of Iron	25 grains.
Glacial Acetic Acid	½ drachm.*
Water	1 ounce.

The image quickly appears, and as soon as the detail is all out, the plate is washed, and fixed in a 15-grain Solution of Cyanide of Potassium, or a saturated solution of Hyposulphite of Soda. The plate is then washed, dried, and varnished.†

* The Glacial Acetic Acid may be replaced by the cheaper No. 8 Acid, using from 45 to 90 minims according to light, subject, etc., etc. (See page 51.)

† The film of a Collodion Plate is much more soft and easily injured than that of a Gelatine Plate. Care must be taken not to let the plates be roughly handled before varnishing.

CHAPTER VI.

BATH DRY PLATES.

THE object of the processes now to be described is to preserve Collodion Plates so that they may be used at a future time. The plates are decidedly less sensitive than Wet Collodion, or even the slowest Gelatine, but the writer determined to devote a short chapter to them for two reasons: first, the ease and quickness of the development and finishing; and, second, their economy when compared to Gelatine Plates.

A suitable closet or large box must be arranged in the dark room for the drying. A number of small glass tumblers are set around the walls of the closet so that the prepared plates can be rested against the wall, and have the lower corners supported diagonally in the tumblers. The film sides are always to be turned *away from the wall.*

The glass plates are cleaned, albumenized, coated with Collodion and sensitized in the bath, just as described in the last chapter; all

of the operations, of course, being done by yellow light. After the plates are fully sensitized, they are removed from the bath and laid in a dish of distilled water, rocked to and fro a few times, while another glass is coated and dipped in the bath. The first glass is now removed to a second dish full of water, the second glass in turn being transferred from the bath to the first dish. The plates must now be well washed under the tap for several minutes, dipped into a 5-grain solution of Bromide of Potassium and again rinsed off, when they are ready for the preservative.

The following mixtures all give good results, and the plates made with them have excellent keeping qualities. They may be used for out-door views or Transparent Positives (see Chapter IX.), but are not sensitive enough for portraits in-doors.

Gum Gallic Preservative.

Gum Arabic	20 grains.
Rock Candy	15 grains.
Water	2 drachms.

Pulverize the Gum and Sugar, and dissolve in the water. Immediately before using, add 3 grains of Gallic Acid dissolved in 6 drachms

of *hot* water and cooled. Filter first through a piece of sponge placed lightly in the neck of a funnel, and afterward through one thickness of grey filtering paper. As this preservative does not keep very well, it should be used up soon. It strikes a yellow tint when mixed.

Gum Tannin Preservative.

Tannin	10 grains.
Gum Arabic	6 grains.
Sugar	4 grains.
Water	1 ounce.

Dissolve and filter, afterwards add 3 grains of Gallic Acid dissolved in a drachm of Alcohol. This solution will keep for years.

Gum Coffee Preservative.

Boil together half an ounce each of Gum Arabic, White Sugar, and Coffee, in twelve ounces of water for ten minutes. Filter. This preservative should be used up soon.

Fothergill Process.

This process is somewhat different from the others. The plate, after being removed from the bath, is laid in the dish of water and rocked about until the greasy lines disappear. Without further washing, the following is applied to the film:

White of Egg	1 ounce.
Water	3 ounces.
Ammonia	10 drops.

The plate is then laid under the tap for a few minutes, and flowed with a wash of an ounce of water containing 10 drops of Glacial Acetic Acid. It is again washed, and dipped in a pan containing a three-grain solution of Gallic Acid. The plate is then set up to dry.

The best plan of applying preservatives is to make a sufficient quantity to cover the plate when laid in a pan. Some time should be allowed in order to let the film absorb all that it can, and the plates are then immediately set up in the drying closet. No draughts of air must be allowed access to them, and the doors of the closet must not be opened until they are quite dry, otherwise a streak will form at that particular point. In cold weather, warmth must be supplied by means of a hot brick or water bottle. It is scarcely necessary to add, that all the solutions must be well filtered, and the manipulations performed with care. No traces of the bath and preservative solutions must ever be allowed to come together, and *the fingers must always be washed after using the one before touching the other.* If a red fog is seen on the developed negative, it is

proof that the washing was not thorough enough to remove the free Nitrate of Silver. The plates must be *absolutely dry* before exposure. Baking them in an oven is often resorted to with good effect.

The plates are developed by means of the Alkaline Pyro. Developer, the formula for which is given on page 88. These plates work best with a much weaker solution than is used for the Gelatino Bromide. A faint image only appears under the Alkaline Developer, and the plate is then to be washed, flowed with weak Acetic Acid, and strengthened with a two-grain solution of Pyrogallic Acid, containing a few drops of the following:

Nitrate of Silver	20 grains.
Citric Acid	30 grains.
Water	1 ounce.

Dissolve separately, mix, and filter.

The plates are fixed, washed, dried, and varnished like Gelatine plates. Less washing, however, will answer.

CHAPTER VII.

WASHED COLLODION EMULSION.

A DESCRIPTION of the manufacture of the Washed Collodion Emulsion having been given in Chapter III., it will only be necessary here to describe the preparation of the plates and their development.

But before doing this, it will be well to compare this process with the Gelatino Bromide, it being clearly understood that the latter is also a true Washed Emulsion Process, but deals with Gelatine, not Pyroxyline.

Plates ready prepared with Washed Collodion Emulsion are not commercial articles, while Gelatine Plates are. The former is not nearly so sensitive as the latter, instantaneous exposures being rarely or never possible. But a great recommendation and advantage of the former is not only that the Emulsion will keep for an indefinite time, and that the plates made with it have likewise very good keeping qualities, but also that a plate can be made by its aid literally *on a moment's notice*, and so far

as perfection of chemical effect is concerned, it does not yield the palm to the best Gelatine Plate. The manipulations also are so simple and easy, that it is the favorite process for travellers who are compelled to work away from home conveniences, while the preparation of Gelatine Plates would be an impossibility, and that of Bath Dry Plates almost or quite so. A traveller with a bottle of Washed Emulsion is much better off than one who depends entirely upon ready prepared plates. For instance, a number of exposures are made —no matter by what process—and a certain percentage turn out badly. If the Washed Emulsion is at hand, all that is necessary is to clean off the failures, recoat the plates, and take the views over again. While, if only ready prepared plates are at hand, the exposures must be duplicated, using up so many plates that the operator may feel himself in danger of running short before the end of the expedition.

The development of the Collodion Emulsion plate is much quicker, easier, and can be done with an infinitely less quantity of water than that of the Gelatine Plate. The writer has often developed plates $8\frac{1}{2} \times 6\frac{1}{2}$ with two quarts of water; this could not possibly be

done with Gelatine, unless the operator made up his mind to have the plates fade from insufficient washing. The plates, furthermore, will dry in two or three minutes in a warm room, and may be varnished and packed away in a few moments more, while the Gelatine Plate requires very much longer, and can never be heated to hasten the process, the only safe method being to immerse the plate in Alcohol and let it soak until the greater part of the water is removed.

The glass for Washed Collodion Emulsion should be of first rate quality. As it is not usual to albumenize, more will depend upon the condition of the surface of the glass than where the substratum is employed. It is to be soaked in Nitric Acid and washed, as described in the chapter on Wet Collodion, then wiped dry either with a perfectly clean linen cloth, or better, with bibulous paper. Finely powdered French Chalk (Steatite) is then dusted over the glass and well rubbed around with a tuft of cotton. A clean chamois skin is then applied, and the plate polished until the powder has apparently all been carried off. The back and face of the glass are now brushed off with a stiff hog's hair pencil, taking care that there is light enough to see well, and it is

then ready for the Emulsion which is poured on like Collodion.

Care is required in drying the plates. The best plan is to have a closet or large box with shelves, upon which the plates can be supported in an upright position, and hot bricks or water tins placed near enough to the plates to raise the temperature a few degrees. Dust must be carefully avoided. When travelling, a metal plate supported over a good spirit lamp, answers very well: the plates being coated one at a time, and dried by holding them over the hot plate, taking care to move them gently to and fro during the drying, so as to avoid what are known as "drying lines."

Before proceeding to develope the exposed plates, an edging of India Rubber is applied to the edges of the glass to keep the film from slipping when moistened. For this purpose, a small camel's-hair pencil is tied to a stick about the size of a pen-holder, and when dipped into the India Rubber Solution, it is applied to the glass and drawn around each edge, leaving a thin coating of the Rubber on the border of the film.

To make the India Rubber Solution, cut up pieces of *Virgin Gum* very small, put them into a bottle, pour on Chloroform enough to

cover them and soak well. Afterwards add Benzole enough to dissolve the Rubber and form a solution about as thick as cream.

The first step in developing the plate is to moisten the film with a mixture of equal parts of Alcohol and Water. This must be done *evenly*, and the fluid not allowed to check in its course as it flows over the film. After soaking in for a few moments, the plate is laid under the tap and well washed off. An Alkaline Pyro. Developer similar to the one described on page 88 is then applied until the image appears.* The plate is then washed and fixed either in Cyanide of Potassium, or Hyposulphite of Soda as before described, the drying and varnishing being done as usual.

Where there are severe contrasts of light and shade in the view, it is better to develope a faint image only with the Alkaline Pyro., and intensify afterward with Acid Pyro. and Silver (page 81). Where there are no very marked contrasts, however, the Alkaline Developer may be allowed to bring the full density, observing the directions given in the chapter on Developers.

* Washed Emulsion Plates develope better if Carbonate of Ammonia be used instead of the Aqua Ammoniæ. A saturated solution of the salt may be kept in stock in a tightly-stoppered bottle.

CHAPTER VIII.

GELATINO BROMIDE.

The preparation of Gelatine Plates is carried on almost exclusively by specialists who devote their entire attention to it and succeed in turning out plates of great reliability. After what has been mentioned in Chapter III., it will not be worth while to give extended directions for preparing the plates, so few attempting it for themselves.

When we consider the delicate nature of Gelatine Plates, it need hardly be said that care must be exercised as to the manner in which they are stored. Dampness is fatal to them. If they are to be carried on a long journey, it will be well to arrange them in tin boxes well soldered, particularly if part or whole of the journey is to be by water. They should never be kept in a cellar. When a package as it leaves the manufacturer's hands is opened, the greatest care must be taken in replacing the opaque paper so as to guard the remaining plates from stray light. Perhaps

the best manner of keeping them, is to leave them in the original packages, but if they are stored in grooved boxes, it will be well to give the insides a coat of shellac varnish which prevents dust from rising and affords an additional security against dampness.

Proof against the presence of even a trace of white light when the plates are handled is imperatively necessary. Ruby colored light is used by manufacturers, and in most dark rooms, but the plates may safely be developed by light of a deep orange hue, which is less trying to the eyes than red, *not light canary yellow or straw color*. The color of the Ferrous Oxalate Developer is itself a great protection to the film, as it is highly non-actinic.

Almost all manufacturers advertise plates of different degrees of rapidity. The work to be done will of course determine the grade of plate to be selected; but it will often be found that medium plates may be very well used for some kinds of instantaneous work, such as shipping, and well-lighted street views. Carbutt's B plate, for instance, will be found abundantly sensitive for this work, even with lenses like the Rapid Rectilinear stopped down enough to give very good marginal definition. Extra Rapid Plates should be reserved for the most difficult sub-

jects, and the slow or medium used in preference whenever possible. It is a well recognized law in Photography, that the difficulty of obtaining clean results increases *pari passu* with the sensitiveness.

During exposure, every care must be taken that no stray light gains access to the plate. The camera and holders should be proved light-tight by taking them into the full sun, and having capped the lens, and seen that no light is admitted through the stop slot, a plate is placed in the holder, this in turn placed in the camera, and the sliding door drawn out, having first thrown the focussing cloth over the back, so that light may not creep in during the drawing of the door. The cloth is now taken off, and the whole apparatus left standing for a few minutes without removing the cap from the lens. The sliding door is then replaced, the holder taken to the dark room, and the plate developed. If it shows any tendency to discolor under the developer, there is a leak somewhere, which must be sought for and stopped. If there is any suspicion about the dark room, the same plan must be pursued here.

When working out of doors, the operator should always be provided with a note-book and pencil, so as to keep an account of the

number of plates exposed, as well as full data as to lens, stop, strength of light, character of subject, grade of plate, etc. It is only by following a systematic course in these manipulations, and by carefully comparing the results obtained at different times under different conditions, that experience in exposure, upon which so much depends, can ever be attained.

On the return from an expedition, every preparation for development should be made before beginning the work. See that there is a full flow of water from the tap in the dark room, and if there have been recent rains or anything to muddy the water, a double thickness of flannel must be tied over the nozzle of the tap. In such a case, it will be well to make up the developer with filtered water and to have a large jug of the same standing close by. It is presupposed that the water is soft, otherwise the solutions should be made of distilled water or melted ice, and a final wash of the same given to the negative before standing it up to dry, otherwise the inorganic salts of Lime, etc., will crystallize in the film. All the solutions also must be cold, and the plate while wet must never be exposed to a high temperature.

The light must be so arranged that the plate

can be watched during the development, and the eyes shielded from the glare of the lamp. Carbutt's Multum in Parvo Lantern is expressly arranged for this purpose, and is a most useful thing in the dark room.

Having mixed the developer in a graduated measure, the plate is taken out of the holder and laid in a dish.* The holder is then closed again to keep the duplicate plate dark. The developer is poured over the plate, which need not be wetted first, and the dish rocked to and fro to secure equal action. The image soon makes its appearance, and the development is continued until the back of the plate is pretty well darkened. Practice alone can tell when to stop the development. Some plates have films so thin, that it is easy to tell on looking through them when to stop, but others, more thickly coated, must be judged of from the back. As soon as the image is fully developed, the plate is well washed under the tap, and laid in the fixing bath.

If the Ferrous Oxalate Developer is to be used, make up Stock Solutions as follows:

A. Oxalate of Potash . . . . . 5 ounces.
Water . . . . . 20 ounces.

* The best kind of dishes for developing, is the "Agate Ware." Being white inside, the plate is easily seen, besides which they are remarkably impervious to the different solutions.

Add enough Oxalic Acid to give a slight acid reaction.

B.	Sulphate of Iron	100 grains.
	Water	1 ounce.
	Sulphuric Acid	1 drop.
C.	Bromide of Ammonium	30 grains.
	Water	1 ounce.

For use, take four ounces of A, and add to it one ounce of B with five or ten drops of C. Mix well with a glass rod and apply to the plate. The Iron Solution must always be added to the Oxalate, *not the reverse.*

If the image comes up very slowly and is weak, add additional Iron, two drachms at a time; but the proportion of Iron to Oxalate must not exceed one to three, otherwise a precipitate is thrown down. If the image flashes out rapidly owing to overtiming, pour out, say, a drachm of the Bromide (C) in a glass, pour the developer off the plate into the Bromide, mix, and return to the plate. Undertimed plates have been successfully treated by adding a few drops of a very weak solution of Hyposulphite of Soda to the Ferrous Oxalate Developer. An excess, however, fogs the picture, and gives a thin grey image. About twenty drops or less of a 2-grain solution are added to every ounce of Developer.

If Alkaline Pyro. be used, make up Stock Solutions as follows:

A. Pyrogallic Acid . . . . . 2 grains.
Water . . . . . 1 ounce.

Adding to every four ounces a crystal of Citric Acid the size of a pea, if the solution is to be kept for any length of time. In this case, the bottle should be filled to the neck and well corked.

B. Aqua Ammoniæ . . . . . ½ ounce.
Water . . . . . 10 ounces.

C. Bromide of Potassium . . . . . 60 grains.
Water . . . . . 1 ounce.

Take enough of A to cover the plate, add fifteen or twenty drops of C, and from one to three drachms or more of B, according to exposure. Solution A does not keep well, so it is best made up in small quantities. If the image appears slowly, add more of B; if it flashes out, restrain it with C. If more density be needed, add more of C with a few grains of dry Pyro.

The development with Ferrous Oxalate is always slower than with Alkaline Pyro. Sometimes as much as fifteen minutes is required with the former.

Mr. Carbutt gives the following as specially adapted to the plates of his manufacture:

No. 1.

Water, distilled or ice . . . . . 10 ounces.
Sulphite of Soda Crystals . . . . . 2 ounces.
Dissolve and add slowly one drachm sulphuric acid.
Pyrogallic Acid . . . . . 1 ounce.
Water to make up 16 ounces fluid.

No. 2.

Water . . . . . 10 ounces.
Crystallized Sulphite Soda . . . . . 2 ounces.
Carbonate of Potash, C. P. . . . . 4 ounces.
Water to make up to 16 ounces.

N. B.—During Summer add 30 grains Bromide Potash or Ammonia to No. 1.

Developer.

"For Portraits on 'Specials,' add to 2½ ounces of water, distilled, melted ice, or well water, but *not rain* water, two drachms each Nos. 1 and 2; less of No. 2 is required during warm weather. If more density is desired add more of No. 1, if more detail and softness add more of No. 2, Bromide to be added to restrain and give density if required. Keep solutions cool, 60 to 70 degrees is a good temperature.

"For Landscapes and Interiors on 'Specials,' where the exposure may be uncertain, lay the exposed plate in the Pyro Solution for a minute or two, then into the developing glass put half the quantity of No. 2 as has been taken of No. 1, and pour the Pyro Solution into it, and back

on to the plate; by proceeding in this manner, adding more of No. 2 to bring out the image, or a few drops of a 10 per cent. solution of Bromide to restrain, as may be required, much better results may be looked for than if a full quantity of No. 1 and No. 2 were mixed at once. **For instantaneous views** or very dark Interiors, we recommend the following procedure: To 4 ounces water add 1 drachm No. 2, soak plate in this while preparing the following: water, 3 ounces, of Nos. 1 and 2 each 3 drachms, 5 drops Bromide Solution, pour off the dilute alkali, and flow this strong developer over the plate; be careful to expose the plate as little as possible to the light used to develop by, no matter how safe it may be considered for ordinary development. Do not hurry by adding more No. 2; cover up the pan and give the developer time to act, when more of No. 1 or No. 2 may be added as may be required. **For instantaneous views on water,** it will be best to treat the plate same as for Landscapes, by soaking plate in Pyro Solution first.

"For Landscape, Machinery, Architecture, etc., on B plates, use ½ drachm each Nos. 1 and 2 to each ounce water, adding more of each as may be required, No. 1 giving density, No. 2 giving detail and hastening development.

"After rinsing off developer, immerse in 10 per cent. Solution common alum, 3 to 5 minutes, then wash and fix in Hypo Solution, Hyposulphite of Soda, 4 ounces, water, 20 ounces, after which wash most thoroughly and dry spontaneously, and varnish with Keystone Negative Varnish. Should the film have a yellow tinge after fixing and washing, immerse for a few minutes, or until color is removed, in the following Bleaching Solution:

Water	20 ounces.
Alum	$1\frac{1}{2}$ ounces.
Sulphuric Acid	$\frac{1}{2}$ ounce.

Wash afterwards and dry spontaneously.

A little practice with developers applied to plates that have been slightly over- or under-timed, will soon teach the beginner how to modify the solutions to suit circumstances. We do not mean by this to advise the constant change of formulæ; indeed, this is where many fail, owing to the wide differences of these formulæ. The best plan is to make choice of a developer, and of a certain batch of plates by a manufacturer of reputation, and then adhere to the general formulæ, merely altering the proportions of the ingredients, as shown above, to suit the different degrees of exposure.

The following formula is given by Mr. Cramer of St. Louis. It is highly recommended:

Stock Solution.

Sulphite of Soda (Crystals) .	3	ounces troy weight.
Bromide of Ammonium * .	$\frac{3}{4}$ or 1	ounce troy weight.
Bromide of Potassium . . .	1	ounce troy weight.
Pyrogallic Acid	2	ounces troy weight.
Dissolve thoroughly in pure rain, distilled or ice water	32	fluid ounces.
Add Sulphuric Acid c. p. .	120	minims.
Concentrated Liquid Ammonia, 26° B. (sp. gr. 0.900)	3	fluid ounces.

Add water to make up bulk to 40 ounces.

"Be careful to measure the Sulphuric Acid and the Liquid Ammonia very accurately, and keep the latter in a cool place, well stoppered, so that it will retain its full strength.

"(Instead of 3 ounces Crystals, 2 ounces granular Sulphite of Soda may be substituted to produce the same effect.)

"The solution assumes a bright ruby color and will keep a long time if kept in a bottle with tight-fitting india-rubber stopper.

"Dilute sufficient for one day's use in the proportion of 1 part Stock Solution to 11 parts Water.

"For over-exposed plates, or in all cases where

* If you prefer intense negatives, use 1 ounce Bromide of Ammonium, but if you prefer soft negatives $\frac{3}{4}$ ounce will be best and will allow shorter exposures.

great intensity and contrast are desirable, add to the diluted developer a few drops of a solution of 1 part Bromide of Ammonium in 10 parts of water, which should always be at hand for this purpose.

"For white drapery, solar negatives, etc., where softness and fine details are desired, give a full exposure, and use 1 part Stock Solution with 16 parts of Water.

"If the plate was under-exposed, do not rock the developing dish too much, to prevent great contrast.

"Wash well before fixing, and prepare the fixing bath as follows: First dissolve ½ pound powdered Alum in ⅓ gallon water; then dissolve 1 pound Hyposulphite of Soda in ⅔ gallon water. After both are dissolved, pour the Alum solution into the Hypo."

Many failures will be avoided if separate dishes are kept for the developer and the fixing solution. By rights every solution should have a dish devoted to itself. This is the plan pursued in large establishments. If the Amateur contents himself with but few, they must be well washed after use, and turned bottom upward to dry.

Those who have been used to the working of ordinary Dry Plates will be apt to carry the

plate out into the light as soon as the image is developed, so as to judge of its quality. This must never be done with Gelatine Plates. Even if the film does not discolor to the eye, it will be affected by the light, so that sometimes fixing is interfered with or rendered quite impracticable. No actinic light must be admitted to the film until the Hyposulphite of Soda has fully done its work as evidenced by the uniform transparency of the plate. A most thorough washing completes the process, after which the negative is put in a rack and allowed to dry spontaneously.

Every pains should be taken in order to secure the proper density by accurate exposure and development; all methods of intensification being more or less unsatisfactory. If, owing to any cause, the image remains thin, and cannot be made to assume the proper intensity, the plate must receive a bath of Alum, or of Alum and Sulphuric Acid in the proportions given above for the "Bleaching Solution." This must be done *after* the Hyposulphite has been thoroughly washed off; as the object of the Alum and Citric Acid is to eliminate the last traces of Hypo, and get the film into proper condition to bear the Mercurial Solution, and is necessary whether the

Hardening Solution be employed or not. Gelatine films always require more washing than Collodion.

A. Bichloride of Mercury . . . . . 10 grains.
Water . . . . . 1 ounce.

B. Aqua Ammoniæ . . . . . 2 drachms.
Water . . . . . 4 ounces.

The negative, having been washed and dried, is laid in a dish and covered with a sufficient quantity of the Mercury Solution A. Leave it for a few moments or until the film becomes somewhat greyish, then wash well under the tap for say ten minutes. Having a quantity of Solution B ready in another pan, immerse the plate, which will immediately become dark brown in color; it is then taken out, well washed and dried.

Gelatine negatives may be printed from without a previous varnishing; indeed, after the Mercurial intensification, no attempt of the kind should be made. Care must then be taken that the sensitive paper is perfectly dry, for the slightest moisture would cause staining of the negative from the free Nitrate of Silver on the paper. It will always be well, with negatives developed in the ordinary manner, to apply a good varnish like Carbutt's Keystone Dry Plate Varnish. Still, the films are

very hard when once thoroughly dry; in fact the varnish is more intended to guard against the staining of the film from damp sensitive paper, than to prevent scratching. The dried plates will bear quite hard brushing off if the brush be dry; this should always be done before putting plates into the holders, so as to remove dust and prevent pinholes.

It sometimes happens, particularly with the slower grades of Gelatine Plates which always tend to develope with more vigor than the rapid ones, that there is an excess of intensity which yields blocky and hard prints. The best method of reducing them, is to apply the Mercurial Solution A above, until the film has darkened; not bleached as for intensification, unless the negative be very much over-developed, otherwise there is risk of losing the finer detail. After thoroughly washing off the Mercury, the plate is laid in a strong and *freshly-made* solution of Hyposulphite of Soda which will reduce the strength. The Hypo. Solution must not have been used for fixing plates, for it is a curious fact that when Solutions of either Hyposulphite of Soda or Cyanide of Potassium *containing Silver*, as of course is the case with old fixing baths, are applied to the plate after treatment with Mercury, an intensifying action takes

place. This can be practically made use of in intensifying negatives, and gives excellent results. It is peculiarly well adapted also for toning Transparent Positives. If a solution be purposely made, dissolve half an ounce of Nitrate of Silver in twelve ounces of water, and the same quantity of Cyanide of Potassium in a separate twelve ounces of water. Mix together, and stir until the precipitate is redissolved. After the plate has received the Mercury and been well washed, it is drained, and the Cyanide of Silver evenly applied. The action is very quick, and the plate must be again washed before any reduction of intensity takes place, which will happen, if the solution be left on too long. There must be a slight excess of free Cyanide of Potassium in the solution.

CHAPTER IX.

PRINTING.

Besides the Photo-Mechanical printing processes which require much costly apparatus, there are three principal methods, viz., Silver, Platinum, and Ferro-Prussiate or Blue Printing.

The latter is selected by many who, not having much time or proper appliances, are content with such proofs as the process affords, even if they have no great claims to beauty or artistic merit. The paper, floated on a mixture of Citrate of Iron and Ammonia with a certain quantity of Red Prussiate of Potash added, is generally bought ready prepared, and only requires to be exposed under the negative in a suitable printing frame and thrown into cold water, which at once developes and fixes the picture.

The Platinum Process, by which very beautiful prints of a rich black tone may be made, stands intermediate between the former and the regular Silver printing on plain or Albumenized

paper as to the labor required. In this case also, the paper is generally bought ready sensitized, but as it does not keep so well as the Ferro-Prussiate paper, it is advisable to use it up within say a month or six weeks. Under any circumstances, the paper ought to be kept in a drying tube, that is, a tin case with tight-fitting lid and a false bottom, below which is a quantity of dried Chloride of Calcium, in order to absorb moisture from the sheets of paper which are rolled up in the upper part of the case. The paper is sensitized on a mixed solution of Ferric Oxalate and Potassic-Chloro-Platinite. When exposed to light under the negative, a pale image is formed which is developed by floating the paper on a hot solution of Oxalate of Potash. The development is instantaneous and very beautiful, the picture immediately appearing in its full vigor. The print must now be passed through two baths of weak Muriatic Acid, to remove the Iron salts, and a washing in ordinary water of half an hour completes the process. It is a great point in favor of the Platinum Process, that the results are permanent, the picture consisting of pure metallic Platinum.

Silver printing on Albumenized paper must still rank as the chief photographic printing

process notwithstanding its numerous rivals and the repeated attempts which have been made to displace it. So far as beauty of result is concerned, nothing but the best efforts of the Woodbury Process can even approach a well-executed Silver print.

Although various plans for preparing "permanent sensitive paper," as it is termed, had been published for many years in the photographic journals, still the paper was hardly a commercial article in this country until very lately. Now, however, the leading stock-dealers advertise "Printing Outfits" which contain all articles required in the printing process, just as the ordinary outfit contains all the necessaries for the negative. Those who purchase such an outfit, will find, besides the chemicals and apparatus, a formula specially adapted to the ready sensitized paper, to which the reader is referred. The manipulations consist, as before, in first cutting down the paper to the required size, exposing under the negative (in this case until the image appears *decidedly darker* than it is intended to be when finished), washing in water, toning, fixing and washing thoroughly as will be described below. Very good prints have been made on this ready sensitized paper, but the writer would advise

all who can to study the regular process of printing, now to be described, both for their own understanding of the process, and on the score of economy.

Albumenized Paper is never made by the photographer himself. Like other articles referred to in this work, it must be done on the large scale and requires specially trained workmen. It might seem at first to be no very difficult matter to add from five to ten grains of Chloride of Ammonium or Sodium to an ounce of the white of egg, and after beating to a froth and allowing the mixture to liquefy again, to float sheets of paper upon it and dry them. But it will be found in practice, that unless this operation be performed with the utmost dexterity and in a perfectly methodical manner, much valuable material will be wasted and the paper unevenly coated, in which case a good print is out of the question.

All dealers in photographic materials keep a varied assortment of Albumenized papers, of different thicknesses and tints. For most purposes a pure white paper is the best, but a pleasing effect may occasionally be made by selecting a paper with a rose or pearl tint. In buying paper, avoid if possible those brands that have an offensive odor, for besides its be-

ing highly disagreeable to work with them, it is fair to presume that the prints will fade, owing to the sulphurous matters which are always formed in decomposing Albumen. Never roll a sheet of Albumenized Paper, if it can possibly be avoided, but provide two clean boards the size of the sheets, and press the paper between them in a dry place.

In order to be able to carry on the operations of photographic printing with ease and convenience, the room devoted to the purpose should be furnished with a water tap and sink, and either communicate with another room facing south, or be provided with drawers in which the sensitized paper can be stored, if the printing be done from the windows of the room used for floating. In the latter case, orange colored window shades must be provided so that sensitizing, toning and washing can be safely carried on. Although the sensitive paper should not be exposed to white light unnecessarily, yet no harm will result from filling the printing frames with the shades drawn up, if a little expedition be used. But it must be repeated, that a southern exposure so as to have full sunlight is imperative. If there is a deficient water supply, the prints may be moved to any convenient locality as soon as the fixing time

has elapsed; a short washing before toning being required, as compared to the washing after fixation, which must be very thorough in all cases.

The numerous formulæ for preparing the printing bath or solution of Nitrate of Silver on which the paper is floated to render it sensitive to light may be classed in two divisions: (*a*) the Ammonio-Nitrate, and (*b*) the plain silver solution. Many operators content themselves with merely dissolving 40 to 60 grains of Nitrate of Silver to each ounce of water and floating the paper without any further additions. The concession, indeed, must be made that the results so obtained are very good, but it will be found that unless an addition of Carbonate of Soda or Liquor Ammoniæ be made, the solution will soon turn red, and become in time perfectly black, owing to the dissolved Albumen from the paper forming a compound with the Nitrate of Silver. By shaking up the bath with Kaolin and filtering, the color may be removed, but it is far preferable to keep the solution always slightly alkaline, as mentioned above, and shielded from the influence of actinic light, particularly just after paper has been floated upon it. It must be borne in mind that acid solutions of Nitrate

of Silver, and perhaps neutral ones also, possess the property of holding a certain amount of organic matter (notably Albumen) in solution and combination, which cannot be gotten rid of by the action of light or heat. Alkaline ones, on the contrary, do not possess this property. Therefore, the addition of a pinch of Bicarbonate of Soda to every quart of plain silver printing bath coupled with rigorous exclusion from daylight will keep the bath clear and colorless.

The Ammonio-Nitrate solution was long ago proposed, on the ground of its giving a more vigorous image of a warm purple-black tone. A *pure* Ammonio-Nitrate solution—*i. e.*, one prepared by adding Liquor Ammoniæ to a solution of Nitrate of Silver until the brown precipitate of Oxide of Silver is redissolved—is open to two objections. First, the solution is so extremely prone to reduction, that spots and defects are very likely to occur on the print, and for the same reason it will be found that the paper, no matter of how good quality, turns yellow very soon after being sensitized even in cool weather. In the second place, the excessive alkalinity will in many cases either dissolve the Albumen from the paper, or at least deaden its glossy surface and give prints with

a flat and sunk-in appearance. The following formula is given with the full assurance of its excellent working qualities, as proved by constant use for years: For one quart of bath, take 1600 grains of Nitrate of Silver, dissolve in four ounces of water and add half an ounce of strong Ammonia. Redissolve the brown precipitate with a few drops of a saturated solution of Nitrate of Ammonia. The solution being now strongly alkaline, enough pure Nitric Acid is to be dropped in to leave only a *faint alkalinity.* Dilute with water until the whole measures 29 fluid ounces, and then add 3 ounces of Alcohol. Finally, add a saturated solution of Alum, a few drops at a time, until a permanent precipitate begins to form.

Complex as this formula may seem, it is not unnecessarily so, every ingredient having an important part to play. The Nitrate of Ammonia is an efficient substitute for the more caustic alkali used in redissolving the Silver Oxide. The Alcohol aids the rapid drying of the paper and the thorough coagulation of the Albumen which is favored even more by the Alum, although the solution can only be made to take up an infinitesimally small amount of the latter. The pureness of the whites of the print is rendered very sure by the presence of

the Alum, as are also the good keeping qualities of the paper after sensitizing. The bath will never discolor if kept in a dark place, and will only need filtering before use.

The sheets of Albumenized Paper as bought from the stock dealers measure about 17 inches by 22. It will be best not to cut them, but to provide a dish large enough to sensitize the whole sheet at one operation. If the amount of work done is not very large, so that the Silver Bath will not have to stay in the dish for a long time, a cheap and very efficient substitute for the costly porcelain dishes of this large size, may be made of wood, into the grain of which pure Paraffine is forced to enter by means of a hot iron. Another great advantage of the wooden dish is, that being light, it is much more easy to handle than the other kind, and the solution will pour out of one of the corners, guided, as it were, by the greasy nature of the Paraffine coating without any risk of spilling, while it is sometimes almost impossible to empty a large porcelain dish without very considerable loss, particularly if the lip is a little defective, as is often the case.

The Silver Bath being poured into the dish to the depth of about half an inch, and care taken that it stands level, the paper is seized

by two diagonally opposite corners and carefully floated on the bath by first lowering one of the free corners* till it touches the liquid, and then gradually allowing the rest of the sheet to follow, so that the air is expelled from before the sheet as it descends. Beginners will often enclose a few air bubbles under the paper; every corner in turn is to be lifted, and if any are seen, they must be broken by touching them with a dry glass rod. If the edges show a tendency to curl up, no attempt must be made to force them down with the finger, but the mouth should be brought close down, and gentle breathing persevered in until they lie flat. The paper is left on the bath from one to three minutes, or until the solution has penetrated well into the paper without making it soggy.

The sheet is now lifted *slowly and evenly* from the bath, and either pinned with *black pins* against the projecting edge of a shelf, or suspended by spring clothes pins from a string hung across the room. The few drops of silver solution accumulating at the lower end are to be taken off with blotting paper, and the sheets allowed to hang until *absolutely dry*, care being taken not to let the lower corners

* With the Albumenized side downward, of course.

curl up during the drying. This may be prevented by attaching a weighted clip, or pinning them down.

It is very convenient to sensitize the paper on the evening before the day it is to be used. It is quite practicable to do this without risk of the whites turning yellow, if the paper be of good quality and the bath made by the formula given. It not unfrequently happens, when this plan is pursued, that the weather on the following morning is such that printing is impossible. To provide against this contingency, some large sheets of white blotting paper are to be soaked in a saturated solution of Bicarbonate of Soda and dried. Sensitized paper, if laid between two sheets of this Soda paper and pressed tightly in a large printing frame or copying press, will remain white for a long time. The writer has made prints on paper kept in this way for ten days without any loss of good quality. It need scarcely be said that the fingers must never touch the sensitive surface, and that a bone or ivory paper knife should be used for cutting the folded sheets.

The next step in the process is the fuming—a large box with grooves at the ends, into which wooden frames having the paper attached by

pins can be lowered like glass plates in the plate box, and a false bottom of wood perforated, with a drawer underneath for the dish containing Ammonia, is the most convenient arrangement. Failing this, an ordinary trunk may be used, the paper being pinned on the inside and a dish with Ammonia standing on the bottom.

The Ammonia should be used in sufficient amount to fill the box with the fumes; in fact, it can hardly be too strong. An ordinary porcelain pan answers very well for holding it, but it should always be warmed before pouring in Ammonia, for the rapid evaporation creates such intense cold that sometimes the dish becomes icy, and will not admit of the escape of the fumes. The proper plan in fuming paper is to use very strong Ammonia and leave the paper but a short time exposed to its action. Ten minutes will be about right.

After removing the paper from the fuming box, it is cut down to the required size. The neatest way to do this is to trim the paper with a glass form and knife on a sheet of glass, in a manner similar to the ordinary print trimming. Care must always be taken to cut the paper a little smaller than the negative, so that it may lie perfectly flat in the printing frame with-

out its edges interfering with the sides of the frame.

The negatives having been selected and laid in the printing frames varnished sides uppermost,* the sensitive paper is laid upon them (with the albumenized side down), the springs at the back of the flaps fastened down, and the frames then exposed to the sun perpendicularly, *i. e.*, not allowed to lie flat, otherwise the edges of the frame would throw shadows upon the negative. When the negatives are not very dense, a sheet of white paper should be pasted over the front of the frame so as to moderate the power of the sun's light. Many prints are spoiled by being made in too bright a light; therefore, if a negative that looks well when held in the hand gives a feeble muddy print, it should be tried again under one or more thicknesses of paper.

The progress of the printing must be watched by opening one of the sides of the door at the back of the frame and examining the print.

* The surface of the negative should be free from dust and grit, and care taken that nothing intervenes between the paper and the negative. The springs must not be forcibly buckled down or the negative may crack under the sudden pressure. No false lights or reflections should be allowed to strike the printing frame. Neglect of small details like these is often followed by much vexation and loss.

The print must be exposed until decidedly darker than it is intended to be when finished. A box or drawer should be at hand to hold the printed proofs until all are done. They are then to be thrown into a pan of water arranged in the sink in the dark room, and washed by allowing the water to circulate from the tap through the dish for fifteen or twenty minutes. It will be noticed that they become somewhat lighter and decidedly red during the washing.

They are now ready to be toned. The following stock solutions are prepared:

A. The contents of a 15-grain bottle of Chloride of Gold dissolved in 15 drachms of water.

B. A saturated solution of Bicarbonate of Soda.

Half an hour before toning, take for every sheet of Albumenized Paper 17×22 one drachm of the Gold solution A, and add to it enough of solution B to neutralize its acidity, using litmus paper to make sure. When ready to tone, add to the above four ounces of water; if the weather is cold, the water is used blood warm.

The dark room should be so arranged that feeble white light can be admitted to tone by; it will be found very difficult to judge of the color of the prints by yellow light. Every-

thing being ready, pass the prints into the toning bath, *a few at a time*, so that the pan containing the bath can be rocked to and fro and the prints not allowed to lie close together. They should be constantly turned over, and as soon as the red color has given way to bluish black, the prints are taken out of the bath and laid in a pan of clean water, shielded from white light.

If the fixing bath has not already been made, this should now be done by dissolving one ounce of Hyposulphite of Soda in six ounces of warm water. A liberal quantity of the solution should be prepared, and the prints passed into it in a pan kept for the purpose exclusively. They are to be moved about and turned over as in the toning bath, and left there for ten or twelve minutes. They are then removed to a vessel of water and rinsed off, and finally washed in running water for four or five hours and dried.

Where the water supply in the dark room is limited, the following plan may be adopted: Throw the prints into a pan containing water enough to cover them well, and leave them there, occasionally turning them over, for a quarter of an hour. Then pour a gallon of water into another pan and add one ounce of Acetic Acid No. 8. Throw the prints into

this, and leave them there for say ten minutes, turning them over from time to time as before. This acid wash reddens them very quickly, and must not be allowed to act too long, but they should be taken out and laid in fresh water. They are then toned in a bath made as follows:

Water	3 quarts.
Chloride of Gold	15 grains.
Acetate of Soda	450 grains.

This solution should be made up twenty-four hours before use in cold weather; in summer, it may be mixed in the morning to use in the afternoon.

Toning baths made with Acetate of Soda give rather warmer tones than those with Bicarbonate of Soda. If the bath works very slowly, the pan containing it may be set in another pan filled with hot water. The prints should be fully toned in from three to six or eight minutes.

Glass shapes for trimming the prints by are sold by the stock-dealers. The print is laid on a large piece of perfectly flat glass, the shape adjusted over it, and the edges cut away with a sharp knife. All that now remains to be done is to mount the print on cardboard with a thin solution of fine Gelatine. If they are to be

placed in a scrap-book, the following will be found very useful, not having the same tendency to cockle the thin leaves as a simply aqueous mountant:

Gelatine	2 ounces.
Water	6 ounces.
Glycerine	1 ounce.

Mix the Glycerine with the water and soak the Gelatine in it till soft, then apply heat to dissolve it. While hot, stir in slowly 6 ounces of Alcohol and then add 10 drops of Carbolic Acid to guard against decomposition. Filter through muslin and keep in a cool place. Heat must be applied before using.

The appearance of a print is much improved by rolling it in a rolling press after it is mounted, or passing it through a burnisher. If the card mounts are very large, the print alone may be placed on the bed-plate of the press and the rollers passed over it.* Care must be taken not to roll too much, otherwise the fibre of the paper would be so crushed that the paste would strike in and leave mottled spots after mounting. Rolling after mounting is safer.

The printing in of clouds from a separate negative, which adds so much to the beauty of a landscape, is done in this way: a separate

* A card should be placed between the print and the roller.

cloud negative is made by pointing the camera at the sky when filled with clouds showing considerable contrast of light and shade. Care must be taken to give a sufficiently short exposure, not to over-develope the negative, and yet to secure plenty of contrast, which can easily be done by selecting the right kind of sky, and attending carefully to the development. The landscape negative must have its own sky painted over with some opaque color on the varnished side, care being taken to follow the fine details of the trees, etc., as closely as possible. Where the sky line is very much broken up, so that it is not practicable to follow it exactly with the paint-brush, the back of the negative should be covered with a piece of tracing paper of the same size, pasted on by its margins only. When dry, an artist's stump filled with black lead may be made to follow the sky line as closely as possible; when the negative is printed, even if the work has not been quite accurately done, the diffusion of light prevents the appearance of any sharp line, particularly when the printing frame is covered with the white paper protector as mentioned above. The landscape, having been printed, will of course have a perfectly white sky. The cloud negative is now laid in a suitable print-

ing frame and the print adjusted so as to make the clouds occupy the desired position. All that remains to be done, is to cover the foreground of the landscape either by a dark cloth or a mask of paper roughly cut to fit, and re-expose to the light for a few seconds, moving the cloth or mask to and fro so as to shield the foreground from the light and yet not allow the mask to leave an unsightly shadow on the print

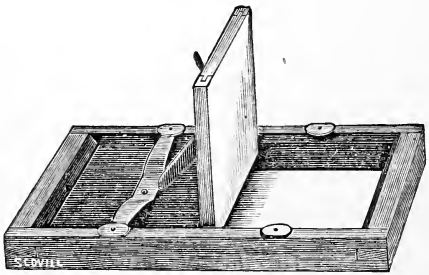

FIG. 13.

as it would not fail to do if left stationary. The to and fro movement vignettes or blends the clouds with the landscape, and with a little practice it can be done with ease and surprising neatness (Fig. 13).

Vignetting, or the gradual blending off of the image into the pure white of the margins, is a favorite way of finishing portraits, and landscapes also will sometimes be very much improved by it. Many landscape negatives

will contain a choice bit in the centre, but the edges consisting of unsightly objects, or of those too near the lens to be perfectly in focus, will mar the effect very much, while if the print be trimmed down just so as to include the centre, it would be entirely too small. Amateur efforts in portraiture, will often contain some object near the head of the sitter that might well be dispensed with, and the drapery near the edge of the plate will frequently be quite out of focus. The vignette, if tastefully managed, will often solve the whole difficulty in such cases.

There are many ways in which the vignette may be made. Bearing in mind that the centre of the picture is to be printed, but not the edges, it will often suffice to lay a cardboard with a hole cut out of its centre over the printing frame, and to keep the card moving to and fro throughout the printing. This answers very well indeed with a quick printing negative, and an improvement may be effected by using two cards, one being laid over the other. This gives a still more perfect blending. Care must be taken to have the cards large enough to fully cover the frame and allow for the to and fro movement, so that the edges may not be uncovered. If printing in the full sunlight, the movement must not be checked, otherwise

a line will be made on the print. If diffused light be used, the perforated card may be tacked down to the face of the printing frame, at the distance of, say, half an inch or an inch from the negative and the frame then exposed. In this case, the light, being diffused, has no tendency to form a sharp shadow and the blending will come of itself, the centre being printed smaller and more decided in outline the nearer the perforated card is brought to the negative, and the more powerful the light, and *vice versâ*. As there is some diffusion of the light after it passes the opening, the printed portion of the picture will always be larger than the actual size of the opening; allowance must be made for this when cutting the card.

Printing frames of the smaller sizes are often so shallow that it will be necessary to set on an extra rim of wood so as to keep the card far enough away from the negative. If the card is covered with tissue paper or ground glass, as must be done in full-sun printing, the same applies here—*i. e.*, the distance between the glass and the card must be sufficient to diffuse the light.

The shape of the opening in the card may be varied at will. An ellipse is the most generally useful, but for some styles of portraiture,

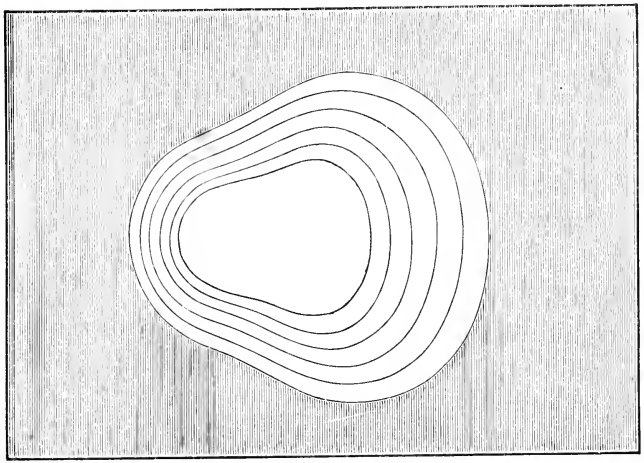

Fig. 14.

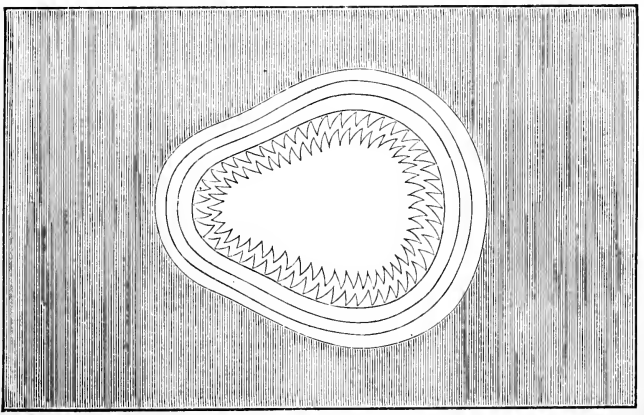

Fig. 15.

good effects may be made with an opening rather triangular in shape, and having round-

ed corners. By cutting such a figure out of the centre of a large card and gluing cotton wool around the edges, a great variety of shapes may be made by simply pulling the cotton in different directions.

The stock dealers sell vignetting papers, as they are called, which are quite convenient, being simply laid on the glass of the printing frame before the negative. In these papers the gradation is made by combining different thicknesses accurately cut out (Figs. 14, 15).

A pleasing effect may also be made by tinting the edges of the vignette after the centre has been fully printed. This may be done by laying the print face down on the glass of the printing frame and shielding the centre with an oval piece of very thick paper which is to be moved to and fro, as already described. A few moments will be enough if the light is tolerably strong, and care must be taken not to allow the shadow of the fingers holding the paper to make a mark. This is easily done by moving the frame round and round.

Tinting edges in this manner will often materially improve a picture in which the lights are low in tone, or deficient, or where there is a superabundance of half tone. Indeed, such different effects may be made in prints

when treated in these ways, that it would be well worth while to make comparative trials from a doubtful negative before printing a large batch.

There is another way of finishing prints, in which the centre is printed as usual, and the edges tinted without vignetting. This also can be made to produce charming effects both in portraits and landscapes. A suitable oval, or other desired shape, is cut out of a piece of non-actinic paper. This must be done with perfect accuracy and care taken not to nick the edges. The large piece with the opening is laid between the face of the negative and the sensitive paper and the print (which will have white edges) made as usual. The cut out portion is now laid upon the print after its removal from the frame and adapted as closely as possible. The whole is now carefully laid in a printing frame and exposed to light for a few seconds so as to tint the white edges—the centre, of course, being protected by the cut-out.

The stock dealers supply machine-cut papers for this purpose which are far better than anything that can be cut out by hand. The beauty of the print will depend upon the neat joining of the tints, and would be quite spoiled

by an irregularly cut paper, or a broad white line intervening between the tints, as would happen if the cut-out was not accurately adjusted. It will help matters, particularly in the first efforts, if both papers are marked so as to render the registration easier.

The remarks that have just been made, really apply in a certain sense to the mounting of the print. There is great scope for the exercise of judgment and taste in the selection of mounting cards for the different styles of prints. It will be found that anything like a blue or rose tint in the cardboard injures the whites of the print, making them look yellow and faded. Pure white cards are seldom as pleasing as those of a buff, stone, or "tea" color. For landscapes, perhaps, nothing is better than a large white card with a lithographic India tint. Portraits and *small* landscapes often look very well on the jet black cards with gilt edges which have lately become so fashionable, but the print should always be cut nearly to the full size of the card, otherwise the effect will be too heavy. Sometimes a perfectly plain card with a fine black line does well, far better as a rule than the fancy mounts covered with gilding and color. In selecting card mounts, a number of different styles should be laid down, and the

print laid on each in succession. The choice of the mount will also be influenced by the tone of the print; the black cards, just alluded to, requiring a full dark purple or black in the print, while the warmer tones, such as are given by the Acetate toning bath, do better on a tea-colored mount.

A chapter on Photographic Printing would be incomplete without mentioning the process of cementing prints to glass by means of Gelatine. This not only adds immensely to the beauty of the print, deepening the shadows, and conferring brilliancy, but it increases the chances of permanency very greatly.

The prints are made slightly darker than usual, and must have a warm tone; not blue nor purple. Good white glass, preferably plate, is then cleaned, and the print trimmed slightly smaller than the glass. The Gelatine solution may be of the strength of an ounce to every pint of water, with a few drops of Glycerine. Enough is prepared to allow the glass and the print to be immersed in it together, and it should be quite hot. After the print has absorbed all that it will, it is brought down to the glass and the two lifted out together and drained, after which the glass is laid flat on a table and an india-rubber squeegee passed over

the back of the print a few times until all air bubbles are pressed out and the print adheres firmly. It will take some little care to remove all minute traces of air, but this must not be neglected, otherwise it will be very unsightly when finished. The whole is to be thoroughly dried, and the face of the glass cleaned off with a wet sponge. The brilliancy of a good print may be increased to a wonderful degree by this simple means, and if mounted in a dark velvet frame will be perhaps the most effective form of photograph producible on paper.

Printing on Glass.—It is universally conceded that a print upon glass, or Transparent Positive, is the most perfect form of photograph, and that it can be made to show the beauties of a fine negative far better than any paper print. The amateur will find a great deal of pleasure in making Glass Positives during the winter evenings, or, in fact, at any time when paper printing cannot be attempted. It will be observed that to make a single paper print, requires the same solutions, and almost the same quantities of them to be made up, as a batch of a dozen or more, while if ready sensitized plates are at hand, a Transparent Positive can be made at a moment's notice by artificial light, and without other chemicals

than are required for the development of a negative.

Transparent Positives are made in two ways: (1) by the camera, in daylight, or (2) by laying a sensitive dry plate on the negative in an ordinary printing frame and exposing to the light of a gas burner.

The first method is generally employed where it is desired to make a positive of different size, either larger or smaller than the negative. Wet Collodion is the most convenient process to employ in this case, but it would be quite possible to substitute any dry plate of good sensitiveness. Two cameras are placed front to front on a long board one end of which is supported on the window-ledge. A southern exposure is best, and a screen of white tissue paper free from defects is placed directly in front of the window. Having removed the front panel and ground glass from the camera nearest the window, the negative is put in the place of the ground glass and held there by a spring. The other camera (the one farthest from the window) is mounted with any good Aplanatic Lens, and brought close up to its fellow holding the negative. The image of the negative will, of course, be thrown on the ground glass of the camera which holds the

lens, but it may require some little search to find it, inasmuch as the object, being so near the lens, will lengthen the focus materially. Supposing that a 6-inch focus lens was used, and that the positive was required to be four times as large as the negative, the focus would be increased to 30 inches, and the negative would stand $7\frac{1}{2}$ inches in front of the lens.

The cameras should be screwed down to the board after the focus has been adjusted, and every pains taken to insure rigidity of the whole apparatus. The plate is then prepared and developed as usual. The exposure will have to be determined by trial, but it may here be remarked that *an overexposed Positive will always have a certain muddy appearance in the half-tones that no after-treatment will remove.* This applies most strongly to such Positives as are meant for exhibition in the lantern either by Lime or Oil Light, and must be carefully guarded against.

Any good dry plate may be used for printing by contact. If lantern slides are to be made, the Taupenot Albumen Process is the best, though many will be deterred from practising it owing to the labor of preparing the plates. Nevertheless, the writer feels that he would not render justice to the subject now under

consideration without giving the details of this old, well-tried, and famous process.

Taupenot Process.

Glass is cleaned, albumenized, coated with Collodion, sensitized, and washed according to the directions given on page 73. Contrary to the processes there described, *all of these operations may be performed in daylight*, for the following, which is applied to the film immediately after the washing, obliterates the action of light:

Iodide of Potassium	15 grains.
Water	1 ounce.

This solution is allowed to rest on the film for a few seconds, or until the film whitens. It is then poured off, the plate drained, and coated with prepared Albumen:

White of Egg	5 ounces.
Iodide of Potassium	35 grains.
Tincture of Iodine	3 drops.
Water	½ ounce.
White Sugar	300 grains

Dissolve the Iodide of Potassium in the water, add the Tincture of Iodine, and mix with the Albumen. Beat the whole to a stiff froth on a china plate with a silver fork. Let the froth liquefy again, and finally add the sugar and

strain through muslin, adding half a drachm of Ammonia. In well-corked bottles this will keep for some weeks in cool weather.

This Albumen is applied twice to the washed plate, which is then dried, and will keep for any length of time. It is insensitive to light. To sensitize the plate, it is dipped into the following Aceto-Nitrate Bath:

Nitrate of Silver	400 grains.
Water	10 ounces.
Glacial Acetic Acid	1 ounce.
Nitric Acid	2½ drachms.

An immersion of 45 seconds is sufficient to sensitize the plate, which must then be taken out and washed very thoroughly in water. The plate should be soaked in two or three pans of water before laying it under the tap. It is then dried and is ready for exposure, and will keep for about two days. If required to be kept longer, apply a 3-grain solution of Gallic Acid in water before drying.

Under a moderately dense negative at the distance of 12 inches from an ordinary fish-tail gas burner, an exposure of from 45 seconds to one minute ought to be enough. The image is developed with weak Alkaline Pyro. followed by Citrate of Silver, as described on page 76. Care should be taken to add the Sil-

ver very sparingly, especially at first. The plate is fixed and toned in the following bath:

Hyposulphite of Soda	6 ounces.
Water	16 ounces.

Dissolve 4 grains of Chloride of Gold in 2 ounces of water and add to the above gradually, meantime stirring well. Finally add a lump of white chalk the size of a pea.

The plate is laid in this solution as soon as the Pyro. developer has been well washed off, when it will be found that as soon as the Hypo. has dissolved the yellow Iodide of Silver, the Gold will have toned the image. The plate may be left in longer if a bluish tone is desired.

As before stated, any good dry plate may be used for making Lantern Positives, the details not differing essentially from the ordinary working of the plate. Excellent slides can be made on Gelatine Plates *under certain conditions.* In the first place, the Extra-Rapid Plates will not answer, but a specially prepared Emulsion where the sensitiveness is purposely kept low, must be used. The developer should always be Ferrous Oxalate and used weaker than for out-door work. It is a good plan to mix, for instance, one-third of an old, red

developer with two-thirds of a freshly made solution. The exposure must be most carefully attended to, as mentioned on page 59. The tone of the slide will depend largely upon the accurate balancing of exposure to development. A short exposure with prolonged development tends to give a cold black tone on almost all dry plates, while a full exposure with short development gives a warm redness. This is particularly true in the case of Collodion Plates of all kinds. The fixing and washing of Gelatine Transparencies are carried out as usual.

Lantern Positives are cut either $3\frac{1}{4}$ inches square, or $3\frac{1}{4} \times 4\frac{1}{4}$ inches. The latter size is the more convenient to work, being the quarter of the $6\frac{1}{2} \times 8\frac{1}{2}$ inch plate. Machine cut paper mats to lay between the slide and its glass cover, as well as paper binders to paste around the edges and hold the glasses together, may be had from the stock dealers. The mats should be cut from paper which is black on one side and white on the other, so that the titles can be written on the inside. Nothing but well boiled flour paste should be used for binding the edges, and care should be taken that the edges of the glass are quite free from grease, otherwise the paste will not adhere.

CHAPTER X.

GENERAL CONSIDERATIONS.

On Posing and Arrangement.

It is a well known fact that the best efforts of the photographer are often looked upon by painters and connoisseurs in general as devoid of those qualities which constitute a work of Art; or, in other words, that being made by a process independent of talent, such as demanded by painting, designing by hand, etc., photographs are essentially mechanical.

Too much ground for the formation of such an opinion has unfortunately been given by photographers themselves. The fact that "a picture" could be made in a few moments by the use of chemicals, and an instrument whose working was easily learned, induced many to take up photography, both as amateurs and professionals, who had not the slightest knowledge of the composition of a picture, properly so called, and no surprise can be felt that artists formed their opinions as they did.

It has been repeatedly said that the camera

and the chemicals should be regarded merely as tools, or as the means by which an idea in the operator's mind is to be expressed in his work. That this is no Utopian theory will be seen at once upon comparing the work of some of the recognized leaders in artistic photography, with that of beginners or careless and slovenly workmen.

It is an easy matter to give formulæ and general directions for making a photograph, but any one having gone through a course of Art-study would smile at an attempt to give rules for making artistic pictures. And yet, strangely enough, a painter or draughtsman taking up the camera for the first time, makes failures in selection, posing, lighting, and composition, to a degree that would scarcely be credited. It takes no little special education of the eye to tell what subjects and what effects of light will be pleasing and look well in a photograph.

While the writer feels that the best advice that can be given to those who wish their work to be good in an æsthetic as well as in a technical sense, is to study portraits, groups and landscapes by masters of eminence, and then either to attempt imitations at a distance, or at least to so analyze and criticise the work that little by little the principles underlying the

whole may become clear, still he feels that a few hints which may serve to overcome some elementary troubles and pave the way for higher efforts will not be out of place.

Beginning with portrait making in-doors, a thing that probably every one handling a camera will undertake at some period of his studies. In the first place, supposing no specially-arranged sky-light like that used in portrait-galleries to be available, a conservatory wholly or partially glazed will answer. A proper background of some neutral tint must be provided, and the sitter placed in front of it, not close to the windows, but well back from them, so as to receive the light and yet allow the camera to stand close in to the glass and thus direct the lens *with* the light and prevent glare and false reflections. The roof, if glazed, and the windows if opening from floor to ceiling must be provided with blue muslin curtains which are set in different positions according to the character of illumination required.

By placing the sitter in position in a firm steady chair, and studying the features as the light falls upon them, the truth of the following directions will at once become apparent: (1) the full force of light must neither proceed vertically from the top, (2) nor from the side, (3) nor

from directly in front. The reason for this will be seen if the blinds and screens are purposely arranged for a moment so as to cause the light to fall as above mentioned, when it will be observed that in the case of (1) the shadows under the nose, lips and chin become immensely exaggerated, the eyes thrown into deep shadow by the overhanging roof of the orbit becoming sunken in and cadaverous, while the top of the head is perfectly white from receiving the full light from above.

In the case of (2), the face would present the most crude and unhappy contrast of chalky high light on the side next the source of light, and heavy shadow obscuring detail on the other.

In (3), the expression of the face would be quite destroyed; no shadows at all being cast to prevent the monotony of the evenly diffused illumination.

A little time spent in experimenting in this manner will soon prove to the beginner that the photographer has a great deal of power over the features according to his management of the light. For instance, a sitter whose features were not prominent, would do well under tolerably strong top and side lights so as to increase the shadows and obtain relief; while

just the contrary would apply to a person with deep, receding eyes, prominent nose, etc., etc.; a liberal amount of front light being best in this case.

A great deal may be accomplished also by the use of screens or reflectors. A light wooden framework covered with white paper may be moved about so as to give a soft illumination of an otherwise hard and obscure shadow.

Portraits may be attempted in any corner room with a window in each wall so as to afford a combination of front and side light. The sitter is placed rather near the larger window and the light from the other one so regulated as to give the necessary modelling, aided by a reflecting screen perhaps. The light under such conditions will be very much weaker than in a conservatory or in the cases mentioned below; indeed a rapid Gelatine plate will be the only proper one to use. Very charming portraits may be thus made in private houses, if care be taken to remove such objects as interfere with the picture. For instance, if working without a background, the edge of a mantelpiece or corner of a picture frame appearing directly in the rear of the sitter's head will be very unsightly, particularly as such objects will always be more or less out of focus.

The sitter must be induced to choose an easy and graceful posture, not obtruding the hands and feet; for as Portrait Lenses magnify those objects which come near, the hands especially will often appear disproportionately large. Any drapery that may be used must fall in flowing curves; not stiff straight lines. Those who have read the autobiography of Catlin the painter, will remember that he came near losing his life when painting portraits in profile of the Indian warriors, their complaint being, that, having two sides to their faces, it was an insult to leave either one out. A great many portrait photographers follow directly in Catlin's footsteps in totally neglecting one side of the face even when the portrait is not a direct profile. Of course that side should be chosen which is the most characteristic and the most free from defects, but the other need not be quite forgotten. The light should be allowed to come principally from one direction, and from one side rather more than the other; this will give a certain relief which may be increased by so arranging matters that the lighted side of the face relieves against the shaded side of the background and *vice versâ;* very nice effects often being obtained by thus graduating the light on the background and not leaving it of

one monotonous color, care being taken at the same time that the face too is not left white, but that there be definite high lights grading off into shadow.

Groups and single figures may be posed and photographed out of doors. Trouble is, however, sometimes experienced here from reflections from surrounding objects. This must be carefully guarded against. It is not a very difficult matter to construct a background with two movable wings, and a top which can be raised or lowered according to the amount of top light desired. The wings may be lined with white paper to serve as reflectors for the face, the background itself being of a neutral tint. Entire studios, in fact, have been constructed in the manner described, the only trouble with them being that they are not waterproof. The inside of a barn has been used with great success for portrait making, the sitter being placed rather near the door, which should face the north, the camera standing either outside, or else inside with the sitter placed sideways or in three-quarter position to the instrument. In this case a background and screen will both be necessary, and the nearer the sitter is brought to the door, the more force will the top light have; the doors

of the barn, too, may be made to control the light coming from either direction. One important point to be borne in mind is not to allow the sitter's eyes to be directed towards the sky or any bright object; on the contrary, a large piece of black velveteen or cloth for him to rest his eyes upon during exposure is an almost indispensable requisite, especially out of doors.

The corner of a yard may sometimes be utilized for making portraits, the background, provided with a curtain or partial roof to keep off excess of top light, being set against one wall, and if the wall standing at right angles to the background does not reflect light enough of itself a white screen may be interposed. All out-door portraiture is better done on overcast than on sunny days, there being less risk of reflections and false lights. Very pretty effects may often be made in a garden, the background being a wall covered with some creeping plant, and overhanging trees or a portico keeping off the top light.

Studies of the larger animals will necessarily be made out of doors. Here, the good effect of the picture will largely depend upon the choice of a good background of the proper color. A light colored horse or cow placed in

front of a plastered or stuccoed wall would give a most unsatisfactory result, just as on the other hand a carriage with a pair of dark-bay horses standing in front of a group of trees or a mass of heavy foliage.

Although foreign to the purpose of the present chapter, it may be mentioned that a great assistance to the successful photographing of animals, and in fact of all moving objects, is the employment of a camera mounted with a "finder." This is a lens the precise duplicate of the one actually employed in making the picture connected with a ground glass, but no plate-holder. The focussing screw of the camera is made so as to control both lenses. The plate having been inserted, and the slide drawn ready for exposure, the animal is watched by means of the finder, and as soon as it assumes the proper attitude, the focus is adjusted, and the picture taken. The time consumed in removing the ground glass and substituting the plate-holder would often cause the loss of the picture and perhaps of an exceptionally picturesque position of the animal, if the finder was not employed and a new focus compelled to be taken for every change in posture. This apparatus is also very useful in photographing infants. (See Appendix, page 191.) In pho-

tographing horses it will be found very convenient to draw a line on the ground, and having placed an assistant there, to focus on him carefully. The groom should then be instructed to bring the animal as nearly upon the line as possible. The operator should choose a moment when the tail is quiet, and endeavor to secure the ears pointed forward, and the legs in such position that at least a part of all four may be distinctly seen. The assistant may step out of the field of the lens and try to attract the horse's attention in some manner, so as to secure the pose referred to.

A study of the rules of Composition should invariably precede attempts at Landscape Photography, and they will be found only second in interest to out-door work itself. The limits of this little work forbid entering into the subject in detail, still a few general hints may be given.

It has been said that the camera is a near-sighted instrument, and there is certainly a good deal of truth in the statement. Distant views of any kind, or extended landscapes are very difficult subjects at best, and in some cases nearly impossible. The greater the distance at which an object stands from the camera, the greater the amount of luminous atmosphere intervening between it and the lens, and conse-

quently the greater the confusion of tint and outline. Clear weather, of course, will have a great effect here; mountain ranges, for example, that look misty and faint in ordinary weather, may sometimes be successfully photographed just after a heavy rain storm which will clear the air, so that in common parlance "the hills look nearer." Distant views containing a large extent of flat or rolling country, such as the panoramic or birds-eye views from the summit of mountain peaks are almost sure to be failures when photographed, not merely because the size of all the prominent features is very greatly reduced, but because the mist, always present in the atmosphere, prevents the formation of either deep blacks or brilliant whites, reducing everything to a monotonous gray tone in which a clean-cut outline is impossible.

But we do not wish it to be supposed that we thus discourage any attempt at distances in landscape. Exquisite pictures of the kind may be made by those who can content themselves to wait for the proper weather and light, and not mind the loss of a few plates. In countries where the hills are bold in outline, and have a good deal of bare rock breaking up the monotony of the shrubbery, most

superb studies of distances may be made, the delicate half-tones melting into each other and contrasted by the deep colors of trees and rocks close at hand, and a sky in which the clouds have been skilfully retained by the means described in the Appendix, forming collectively a subject fit for any artist to work upon.

Among those subjects that are generally situated near to the camera, we may mention *rocks* as peculiarly well suited for photography. Some rivers flow through very rocky channels, forming frequent cascades, and pools in which the reflections of the trees and hills tell to great advantage when surrounded by the water-worn and polished granite. Now and then the backbone of a mountain, so to speak, will descend to the water, giving fine reflections, and only needing a little care in making up the foreground to give a very artistic study; or sometimes an isolated peak will relieve itself magnificently against a sky filled with heavy white cumulus clouds, or even under favorable atmospheric conditions will carry a *moustache* of mist along its sides. A quick exposure on such a subject can hardly fail to produce a beautiful and interesting result, and such a neighborhood will be almost certain

to be fruitful in subjects of another class—forest studies, endless in variety.

Water in the different forms of river, lake, cascade, rapids and breaking wave, may now, by the aid of the sensitive Gelatine Plate be more easily treated than ever before. A well-trained eye would see much to be done in merely cloud effects and reflections in a tame sheet of water such as a dam. Lake views, particularly where the vistas and reaches do not include too much distance, make excellent subjects, and since much of the foreground will be water, attention should be paid to the wind, which will sometimes blow from a direction that will divide up the monotonous stretch, leaving a part still, clear and glossy, while the other takes on a brilliant half light. Or, a large stretch may be artificially broken up by introducing a boat with figures posed as if fishing, etc., etc., or if the surface of the water is spotted with lily-pads, and other aquatic plants, most charming reflections partially broken up by the leaves may be secured. Waterfalls make excellent subjects, but those will be best where the water does not appear in an unbroken sheet or mass giving no detail. Such as are divided by the rock in several places are better, and here it will be well to

remember that when the streams are filled to the utmost after heavy rains, they will not necessarily make the best pictures, while on the other hand, many a beautiful cascade will present but a poor appearance in the dry months of August and September. It is self-evident how the whole ground-work of the picture will be affected by the amount of water passing over the rock.

Rivers with low or flat shores are by no means as favorable, but a careful attention to the foreground, and the judicious introduction of a boat, or a double-printed sky will often save the picture from monotony and flatness.

Trees and foliage have always been favorite subjects, and justly so. The wind will be the great enemy to the photographer here, but it should be borne in mind that in settled fair weather there will generally be perfect stillness in the morning before 9 o'clock and often also in the latter part of the afternoon, say after 5 P. M. The light is by no means as actinic at these times as at midday, but we have the beautiful long shadows which aid very much in making up the view. A trifle longer exposure is all that is necessary. A fine tree is always a beautiful object even in winter when each twig cuts out against the clear sky with

great distinctness. When loaded with snow, or incased in ice after a freezing rain, it is still more interesting; but perhaps the most trying subjects of this class are the leaves when just commencing to unfold in the spring. The new growth is always very light in color, and if the open sky is the background, solarization is to be feared unless the light is carefully chosen and the plate not overtimed. If there is any wind at all, the exposure must be nearly instantaneous and the lens used with large aperture so as to admit all the light possible.

Old buildings covered with ivy or creepers make beautiful pictures. An amount of wind that would render the photographing of a weeping willow quite impossible, will often disturb the ivy on a tree trunk or wall so little that good pictures may be made. Studies of roads with overhanging trees and the sunlight penetrating in streaks and spots will require care in timing and development lest the high lights become too dense and leave a snow-like effect; this is particularly true in Stereoscopic Photography. Sometimes, where the contrasts are very severe, it will be better not to attempt such a subject in a full sun, but leave it for a partly overcast day. The sun striking on a foreground through trees has great action

on the film, so that such a view will often look as though the sunlight was far stronger than it was in reality.

The limits of the present chapter do not permit us to enter at length upon the topic of choice of the point of view, but let us say that now-a-days when the mechanical or technical part of a photograph has been reduced almost to an absolute certainty, pictorial considerations assume greater importance than ever before. In other words, one may go out with his apparatus and feel no doubt of any part of his results save that depending upon *himself*. The pictures that a man makes will be stamped with his own individuality, and will be certain to show his taste or lack of taste, and his appreciation of or insensibility to the beautiful. A man, for instance, who would make a view of a square house with a tree on either side, from directly in front, so that the principal objects arranged themselves in the form of the letter H, might be an excellent photographic operator, but he would not have done so well as another who seeing the difficulties he had to contend against, had perhaps gone a little nearer to his subject, so that the building was made in perspective and the lines of the trees and fences made to run diagonally toward a

vanishing point, thus breaking up the offensive square masses and transforming them into something approximating a triangle.

It has been shrewdly suggested that when pure Landscape is attempted, a good deal may be done by thinking of the name the picture is to bear. A picture which was to be called, let us say, "Mount Washington from the Saco," would naturally be expected to show both mountain and river to a greater or less degree, and would enforce the proper relationship between them as principal objects. Perhaps more failures in artistic composition arise from the desire to show too much in the view than from any other source. The greater the number of objects introduced into a picture, the greater the difficulty of making them compose harmoniously. Care should always be taken to avoid lines which repeat the boundaries of the print, *i. e.*, all square forms or right angles, particularly when near to the corners of the view should be avoided. So should parallel lines either in a vertical or a horizontal direction, but as it very frequently happens that this cannot be helped, the photographer should be familiar with those expedients made use of by painters in similar cases, such for instance as man-

aging the light so that there is a bold contrast of tint in the parallel lines, or in other words making such a study a study of light and shade rather than of line.

It will be understood, of course, that we are now speaking of the general composition of the picture and are dealing with it somewhat after the manner of a diagram, or in other words, that we are analyzing our subject and "*reducing it to its lowest terms.*" If we find ourselves before a view that resolves itself into a number of bold sweeping lines as in mountains, for instance, we should think in what manner these lines can be made to run so as to compose well. Supposing that the view was a notch or pass between the mountains, the lines might be made to cross each other, and special attention be paid to the amount of light or shadow upon either hill at different hours of the day. The general rule for the composition of lines is that they should oppose and contrast with each other, but they ought not to be the precise opposites of each other—a long thin line being more interesting if contrasted with a short heavy one running in a different direction, or supported by a rather small but very prominent point or object, such as a rock with one or more figures posed near

to it, or anything which would arrest the attention. Perfectly straight lines of any kind should be avoided as much as possible, for they make the picture stiff and ungraceful.

The centre of the picture requires very careful treatment. Many subjects undoubtedly must be placed here, but contrary to what is often imagined, *the centre of a picture is its weakest part*, the principal object (if not too large) having much greater value if placed a little off the centre in one direction or the other. Rules, of course, cannot be laid down in matters of this kind, but the following experiment if applied analytically to good paintings will be both instructive and interesting: divide the entire view (supposing the length to be greater than the breadth) into three equal parts horizontally, and three or five vertically, the intersections of the dividing lines will give what are sometimes called "forte points," by artists, from the fact that principal objects placed at these points will generally look far better than if placed directly in the centre. The student in Landscape Photography will find it well worth while to obtain some good illustrated works by artists of skill and reputation, and study the pictures with this idea before him. If such a trial has

never been made, we are sure that he will be surprised to see how often the centre of the view is not occupied by principal objects, but how these latter are dextrously shifted off in the manner alluded to. Still, let us repeat, that this is not intended to be a *rule* to be always blindly followed, nor indeed can any rule be given which might not be violated triumphantly by one possessed of the proper skill and taste. It is just this fact that renders it a matter of great difficulty to give advice respecting the selection of view, the æsthetic considerations of picture making being too subtle and delicate to be treated by formulæ as can so easily be done in the chemical part of the work, and in the choice of apparatus. Skill in the selection of the point of view must be acquired by long and critical training of the eye to the beauty of line, mass, and chiaroscuro, by the unremitting study of good paintings, and by the endeavor to really compose and make *pictures* when out in the field; not by a random photographing of any scene that may happen to please at the moment. Some might shrink from this as being too laborious, but to any one who is really fond at heart of the beauties of external nature, so far from being so, it is a

most fascinating and delightful occupation, and one which is sure to grow more and more interesting, for we thus find ourselves dealing with the intimate essence and nature of the beautiful, and gradually improving our taste, and this is sure to be followed by a keener enjoyment both of pictures and of their prototypes in nature.

Nevertheless, there is much to be learned by those who wish to excel in this direction. The difficulty experienced by the beginner is generally the question how to proceed in his studies and what plan to follow. Our advice here would be to study pictures before venturing out with the camera, and to read all works treating of this subject. One of the best is H. P. Robinson's *Pictorial Effect in Photography*. This is a collected series of papers which appeared in the "Photographic News" for 1868, and gives hints for the analytical study of paintings, which, when mastered, will render it easy for the student to criticise any picture he may see, and afterward apply the principles to his own efforts. We will only say in addition that we have presupposed the beginner to be possessed of tolerable skill in the routine of timing and developing plates, and to own a good service-

able outfit with at least two lenses of different focus. Many a view will have to be sacrificed if the operator confines himself to a single lens, different subjects requiring lenses of different focus. Some of the European photographers carry as many as seven and eight pairs of lenses for stereoscopic work. The trimming of the finished print, also, is a matter upon which much will depend. It not unfrequently happens that a view will be much improved by cutting off a good deal of the foreground. Supposing the camera to have been placed in an ordinary field, little could be expected in the foreground but a monotonous stretch of stubble, which had better be out of the picture than in it. The same will often apply to the sky.

No dependence whatever should be placed on the theoretical actinism of the light at different seasons, no matter how true it may actually be proved to be. The photographer will find that the timing of his plates is a matter in which nothing will help him except that experience only to be attained by careful trial and the comparison of results, as before alluded to. While a meteorologist might stand aghast at the apparently crude calculations of the photographer, the latter would be quite

justified when the great differences between lenses, stops, subjects, character of plates, strength of developer, etc., etc., are taken into account. The scientifically-educated amateur will thus have a number of practical lessons to learn before he can become an expert photographer, from the very fact that many things that might seem to be of paramount importance from the meteorological standpoint go for little or nothing in the practice of Photography.

Architectural subjects, if newly built, will often be best rendered in a half sun, while, on the other hand, if some venerable or ancient building is the subject, a full sun will be none too strong to give the necessary contrast and relief in its walls. The camera should be furnished with a swing-back as described on page 22, in order that the building may not be distorted in the photograph. The careful choice of lenses and of the proper light are of the greatest importance in this class of work. Lenses of tolerably long focus always give the most truthful and pleasing results both in Landscape and in Architectural Photography. A lens whose focal length equals the diagonal of the plate (thus an 11-inch lens for plates $8\frac{1}{2}\times6\frac{1}{2}$) will be very generally useful. But a building often stands in a confined position

where such an instrument could not be made to include the whole of it on the plate. A wider angle lens then becomes necessary, but in some cases where the camera has to be brought very close to the object, the perspective given by a very wide angle lens is so forced and unnatural, that an operator with good taste will prefer to leave the subject unattempted rather than obtain a negative where all the right angles in the original are made to look like wedges, and the whole building apparently squeezed into a point. It is a very easy matter, in this kind of work, to make a well-known building unrecognizable. Difficulty will often be experienced in photographing public edifices and houses of pictorial or historic interest in the midst of large cities. It will always be desirable to work from the window of a neighboring house commanding a good view, rather than to attempt it from the street, even if dry plates be used. A crowd of idlers is sure to gather about the instrument as soon as it is set up, and sometimes photography becomes impossible from this cause alone, unless a police-officer be feed to keep them from encroaching or standing immediately in front of the lens. It is at times like these that mistakes, such as exposing the same plate twice, etc., are very apt to be made.

As Gelatine plates are now made of such sensitiveness that almost any subject out of doors may be taken instantaneously, it becomes a question whether street views and studies of Architecture are best made with the drop so that the resulting negative shows the streets filled with vehicles and people, or whether it is better to use a slow plate and to stop the lens down so as to give a long exposure, sometimes amounting to several minutes, in which case the street would appear quite empty, or perhaps a few faint streaks at the bottom of the plate be all the traces left of the hurrying crowds. The writer has made a large number of street views where the buildings are quite unobstructed by people in the street, having employed Collodio-albumen plates and given an exposure of ten minutes with a small stop. The detail in the darkest shadows, of course, was perfectly rendered by such an exposure, but it is not always that an exposure short enough to render trotting horses perfectly sharp, can also be made to impress the detail in a mass of deep shadow, and it need scarcely be said that if figures are introduced at all into the view, they must be *sharp*. An exposure just long enough to double or treble the heads of horses, or to leave men

minus a leg, as is often seen in street views, produces an intolerable effect.

The photographing of interiors, such as private rooms, halls, churches, and public buildings, will be found to vary in difficulty according to the size (particularly the length), the color of the walls, and the amount of light admitted. One chief trouble is that the camera is generally obliged to stand opposite one of the windows, if not indeed to the chief source of light. In this case it can hardly be expected that the negative will be free from solarization, unless the other windows admit a full flood of light so as to make short exposures practicable, or the window opposite the camera be covered with a curtain. Direct sunlight admitted to any part of the room which is to appear in the picture is very objectionable, though if the room be of large size, the sun may often be thrown into a dark corner or upon some especially non-actinic object by means of a mirror, and thus aid very much in bringing out detail. Care must be taken to keep the mirror moving, so as to prevent crude shadows.

Interiors have been successfully made on Rapid Gelatine Plates where there was so little light that focussing became difficult. A

candle flame serves a useful purpose here; or, if the building be not too dark, a piece of printed matter may be carried to any given point and the focus taken upon it. *A full exposure is always demanded in Interior work to prevent the shadows from becoming patchy and black*, and if there is plenty of light proceeding from a number of windows, excellent effects will often be obtained by covering some or all of them with tissue paper so as to soften the light and prevent the streaky black shadows cast by such objects as, for instance, the legs of chairs, etc.

It is of course only since the use of Gelatine plates that such a feat as photographing tableaux on the stage of a theatre could be attempted. Few, probably, among those to whom this book is addressed will care to try such difficult subjects, but it will do no harm to suggest the propriety of not supporting the camera on the floor at such a time, for the applause and stamping with the feet would be sure to jar the instrument and double the lines of the picture.

Perfect as the work of the lens and chemicals is, a great many negatives will be much improved by the retouching pencil. The most convenient arrangement for this purpose is an

affair like a desk lid standing at an angle of 45° directly in front of a window. A mirror set at a proper angle below the desk (which must have a piece the size of the negative cut out of it) reflects light up upon the negative which has a ground glass screen behind it, and thus becomes evenly illuminated. If the negative has been varnished, a drop of a mixture of Canada Balsam and Turpentine is applied to the part to be worked upon and quickly rubbed off with a tuft of clean cotton until the varnish will take the pencil, but does not become sticky. The negative, being rested on the retouching desk, is then worked upon with the pencil, but care and judgment must be observed, and the delicate detail not roughly cut out or the high lights made chalky and staring. This applies particularly to portraits, a few touches often serving to alter expression in a marked manner. Landscapes may be very much improved sometimes by judiciously putting in a few high lights or strengthening detail that is too feeble to print. All that is necessary is to follow the outline of the objects with care, using a magnifier if the work is of very delicate character. Retouching may often be advantageously combined with the use of tracing paper on the back of

the negative, as suggested on page 111. In this case, all the work to be done with the pencil should be done before the paper is put on.

Double printing, or printing parts of different negatives on the same picture, is done in the manner described for introducing clouds in Chapter IX. When carried out with *taste and skill*, wonderful effects may be made. A portrait taken in-doors, for example, may be double printed on a natural background simply by masking the negatives and taking care to make the joins as neat as possible. It cannot be denied that considerable practice is required to overcome the mechanical difficulties of such work, but the beautiful efforts of Robinson, Nelson K. Cherril and others, are proof of what can be accomplished in this direction.

CHAPTER XI.

PAPER NEGATIVES.

A REMARKABLE instance of the manner in which history—even photographic history—repeats itself, may be noticed in the revival of interest in the use of paper as a support for sensitive negative tissues instead of glass.

The early experimenters in the art were not slow to recognize the disadvantages of glass; chief among which we may name fragility, weight, cost, and the labor of cleaning. In the early times, however, before emulsions were discovered, a paper negative was as rough an affair as the manipulations for obtaining it were tedious and troublesome. One of the favorite processes was that on waxed paper; the sheets cut to size were made to absorb white wax by means of a hot flat-iron, and then soaked for a number of hours in a bath of alkaline iodides and bromides. This was followed (after drying) by floating on a silver sensitizing bath and a washing in water to remove the excess, after which the sheets were

dried and placed in the holders. The length of exposure required, even under favorable circumstances was often as long as twenty minutes, and the development was conducted with gallic acid. Even when papers of the finest obtainable texture were used the negatives and prints showed the granularity of the paper only too plainly, the image being formed partly in and partly upon the paper. Now, an essential and most curious feature of the new method bears directly upon this point; it seems that when the sensitive material is allowed to come into contact with the paper at all, the various inequalities of its surface reproduce themselves upon the sensitive layer, and will thus cause it to show granularity, no matter how fine a quality of paper be chosen. In the new and improved method, a layer of plain gelatine is first applied to the paper, and the sheets passed through a calendering press afterwards. This leaves an exquisitely smooth and even surface upon which the sensitive gelatino-bromide emulsion is afterwards poured. Any roughnesses of the paper will thus be impressed upon the inert gelatine substratum, leaving the sensitive layer perfectly smooth and uninterfered with.

The natural opacity of paper has always been esteemed a drawback to its employment for

negatives. Printing is the operation that might be expected to suffer most in this respect; but nevertheless, a good deal can be done by giving the finished negative a dip into a tray of hot castor oil, afterwards removing the excess by blotting-paper. And this very opacity of the supporting medium for the sensitive film is of decided value during the exposure, *in preventing, or at least lessening solarization.* The general principles, however, that will guide the operator in selecting paper for this purpose will be (1) absence of grain, (2) absence of undue opacity.

Considering the nicety with which the whole process of preparing the paper would have to be conducted if any good results were to be expected, it is plain that if paper negatives are to become popular, the sensitive paper will not be prepared by the operator himself, but furnished by the manufacturers just as albumen paper is now. The quality of such an article, where special arrangements for applying the solutions were fitted up, and the process conducted methodically and on the largest scale by trained workmen, could not fail to surpass that made by an individual to supply his own wants.

The plate-holder of the camera will, of

course, have to be modified. The best plan is to have the paper wound around a spool

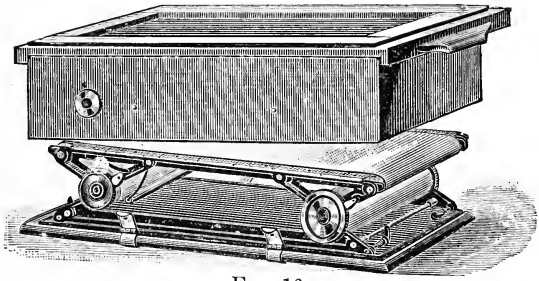

Fig. 16.

standing upright in the holder (which thus, of course, will be increased to perhaps four or five times its ordinary thickness), and crossing over a perfectly flat board to another spool at the other side. The paper is thus put upon the stretch, and being supported also by the board behind, gives a perfectly true surface on which to receive the image. The spools may be supplied with milled heads working on the outside of the holder, so many turns of the head (or spool) being equal to the length of picture required. From actual trial, it has been found that a holder of this nature is not more bulky than three or four double backs, while the paper contained therein will furnish four times as many exposures.

We are informed by those who have devoted

attention to this novelty, that the manipulations are very simple and easy; all that follows the exposure (up to the time of oiling) being just that for the ordinary gelatine plate. The exposed paper, being cut into lengths, is developed in a dish with the ordinary pyro developer, and we are glad to remark that staining seems unknown, as is also frilling—the gelatine adhering to the paper with great tenacity. The drying of the finished negative requires to be conducted with some care, naturally so when we consider the heavy layer of contractile gelatine on the paper. The preferred plan is to have a number of pieces of clean glass ready, whose surfaces have been *talced* or *French chalked* in the manner described on page 79. The wet negative is drained and laid, surface down, on the glass, an India-rubber squeegee being applied to get rid of superfluous water and make the negative lie flat. When dried, it may be stripped off and kept in a book. The oil may be applied by simply pouring some into a tray, and after heating it nearly to the boiling-point, passing the negatives in and out, removing the excess with blotting-paper. It is plain that retouching of any kind, and the combining of parts of various subjects selected at will from other

negatives with each other, are greatly facilitated by paper negatives.

The following directions are those recommended by the Eastman Sensitive Film Co.:

In hot weather use cold water for washing.

The Developer.

No. 1.—Sulphite Sodium Crystals, pure	6	ounces.
Distilled or boiled water	1	quart.
Pyrogallic acid	1	ounce.
No. 2.—Carbonate Soda, pure	¼	pound.
Water	1	quart.

To develop take in a suitable tray—

No. 1	1	ounce.
No. 2	1	ounce.
Water	1	ounce.

Immerse the exposed paper in clean *cold* water, and with a soft camel's hair brush gently remove the adhering air bells from the surface. As soon as limp transfer to the developer, taking care to avoid bubbles by gently lowering the paper by one edge so as to slide it under the surface of the developer.

The image should appear in 10 to 20 seconds and the development should be carried on in the same way as for a glass dry plate. If the image appears too quick and is flat and full of detail add 5 to 10 drops of the

Restrainer.

Bromide Potassium	1 ounce.
Water	6 ounces.

This will keep back the shadows and allow the high lights to attain density.

If the exposure has been too short and the image does not appear except in the highest lights, add instead of the restrainer not to exceed one ounce of No. 2; this will help to bring out the details and compensate in a measure for the short exposure. As soon as sufficient density is obtained slightly rinse the negative and put in the

Fixing Bath.

Hyposulphite Soda	4	ounces.
Water	1	pint.
Common Alum	½	ounce.

To be mixed fresh for each batch of negatives.

The completion of the fixing operation may be ascertained by looking through the film. When fixed wash in 5 or 6 changes of water for 15 or 20 minutes, and then lay the paper negative face downward upon a clean plate of glass or hard rubber that has been rubbed over with an oily rag. Press the negative into contact with the plate by the scraping action of the squeegee, and allow to dry when it will

peel off from the plate with a fine polished surface.

The Oxalate Developer.

This developer also works well with the Improved Negative Paper, and we recommend it for trial.

Formula.

Saturated Solution Oxalate Potash . . . . . 6 ounces.
" " Proto Sulphate Iron . . . . . 1 ounce.

The separate solutions keep well and should be mixed fresh for development, and about 25 per cent. of old developer added to it for use.

Oiling.

Lay the negative down on a clean sheet of paper and give it a coat of castor oil applied with a rag. Then press it with a hot iron until it shows an even dark color. Use plenty of oil. If the iron is too hot it will dry out the oil, and it will be necessary to go over it with the rag again. If the iron is not hot enough it will fail to cause the oil to penetrate the paper sufficiently. When an even color is obtained wipe off the excess of oil with a soft cloth, and the negative is ready to print.

Instead of using a hot iron the negative may be held over the stove until the oil sinks into

the paper. The hot oil expels the air in the paper and fills the pores so that on examination it will be found that the grain has disappeared, leaving a fine ground glass effect. No oil should be allowed to get on the face of the negative; in case it does, it may be removed with a cloth and a few drops of alcohol.

Printing.

Thus prepared, the Negative Paper will print remarkably free from grain and quicker than most pyro and ammonia developed glass negatives. To print, simply lay the negative with the glossy side up on a piece of glass in the printing frame and print the same as a glass negative. The negative does not require fastening to the glass in any way. These negatives should be kept between paraffine paper, or back to back in a printing frame, or suitable box. If the oil dries out after continued use, the negative may be re-oiled.

Retouching.

When the negative is to be retouched, as in portraiture, it should be done after oiling. The paper takes the pencil freely, and persons unskilled will find it comparatively easy to "work" these negatives. Amateurs can spot

their own negatives and work in fine cloud effects with a stump on the paper surface.

Intensification.

When it is necessary to intensify it may be done before oiling by soaking the negative in a saturated solution of corrosive sublimate, washing and then blackening the image with a solution of 10 drops of strong ammonia per one ounce of water.

Where strong negatives are desired, add 5 drops of the restrainer to the developer before using.

CHAPTER XII.

MICROSCOPIC PHOTOGRAPHY.

The term Photo-Micrography, by which is meant the photographic delineation of small or microscopic objects, is frequently confounded with Micro-Photography, the latter signifying the reduction in size of objects by means of the camera, so that they are visible only when examined by means of the microscope.

Pretty, or rather let us say curious results are obtainable by the latter process, as for instance when a voluminous article, such as the entire page of a newspaper, is so reduced in size as to be put into the space of a small pin's head.

Most people, however, are naturally more interested in the former method, by which almost all of the countless wonders of nature as revealed by the microscope, are permanently fixed upon the photographic film, and put into a form that can be shown to large audiences by means of the Oxy-hydrogen Lantern.

In earlier times, before the introduction of

the sensitive gelatine plate, a difficulty was often experienced by those who worked in this direction, from the fact that when a high degree of magnification was necessary (for which high power objectives had to be used) the light was correspondingly feeble, and exposures of almost impracticable length required. This, in turn, necessitated the employment of a "heliostat" or mirror for reflecting the sun's rays, which was mounted with clock-work so as to enable the mirror to follow the sun's march, and keep the illumination on the ground glass of the camera constant and even. Without this, no image of even tolerable sharpness could have been obtained.

Those who attempt the more difficult branches of Photo-Micrography will still have some trouble of the kind to overcome, though as already hinted, the use of a sensitive gelatine plate will go far toward smoothing the way.

As the greater number of our readers will hardly care to attempt those subjects requiring the higher powers—at least in their first trials, we will devote a little space to the description of an apparatus by which very creditable lantern transparencies may be made of the ordinary specimens, little or no addition to the average outfit possessed by the amateur pho-

tographer being required, save the microscope itself.

Not the least attractive part of this department of photography, is that it may be done at night by the aid of any good coal-oil lamp. This gets rid at once of the fluctuations in the intensity of ordinary daylight—a frequent source of failure—as all having had any experience in this direction will admit. The same then is true here as in the printing of Lantern Slides, to which allusion has been made in a former chapter.

For the benefit of those who have never attempted this class of work, we may explain that the image of the specimen (which occupies its usual position on the stage of the microscope) is formed by the objective (the eye-piece being removed), and received on the ground glass of the camera, which is connected with the eye-piece end of the microscope by a tube of suitable length, the body of the microscope having been set horizontal, and the light proceeding from the lamp concentrated upon the object by means of a reflector and powerful condenser placed at a proper distance behind the stage.

The first point to which attention is to be directed is that the whole apparatus must stand in a right line axially, *i. e.*, the microscope

must be set so that the central axis of the tube forms an exact right angle with the ground glass of the camera, and the centre of the flame of the lamp and reflector must also strike

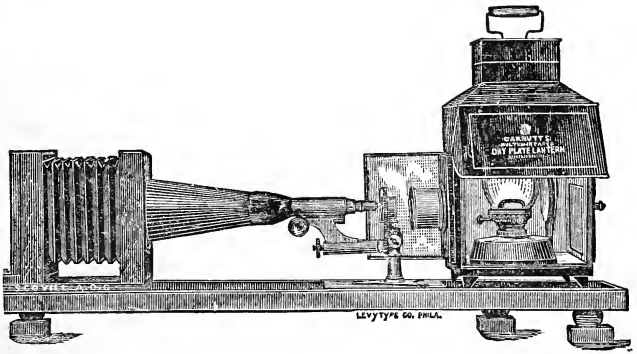

Fig. 17.

the centre of the objective. The readiest means of effecting this will be to provide a stout board of at least an inch in thickness and say four feet in length, well battened with cross pieces on the under side to prevent warping. If an ordinary table lamp be used as the source of light, it may be convenient to cut a circular hole at one end of the board so that the flame may be elevated to about four inches above the board (the lamp being set below) or at least so that it centres with the tube of the microscope. The Fiddian Illuminator has been highly spoken of for this purpose, and another ex-

cellent form of lamp is the Hitchcock Kerosene House Lamp. As the latter has no chimney, it must be protected from draughts of air, but it gives a very powerful and white light.

An achromatic condenser is fitted to the substage, and if this does not give the necessary power of light, an ordinary "bull's-eye" may be interposed between the light and the achromatic condenser. It will be highly necessary to be able to centre the object on the stage with accuracy. Although the simple form of stage will answer if care be taken, convenience will be much furthered by the various forms of stage apparatus as supplied with microscopes of superior manufacture.

The supplementary tube which stands between the microscope and the camera may be made either of pasteboard in a somewhat conical form, or a few feet of ordinary stove pipe may be applied. See that the joints between the microscope and the camera are protected at every point against the admission of light, and be particular to line the large tube and the body of the microscope with *dead black* paper, or what is far better, cotton velveteen, with the pile side facing inward.

When the apparatus is some feet in length, it is impossible to reach the focussing screw of

the microscope when examining the image on the ground glass. This can be provided for by passing a cord around the milled head of the microscope screw (having a suitable groove turned into it if not already there) and carrying it back and passing it over another grooved wooden wheel provided with a winch, and attached to the right-hand side of the base board just below the ground glass.

When working with full sun light the question of the non-coincidence of the chemical and visual foci of the objective may have to be taken into account if low powers are used. The use of an ammonio-sulphate of copper cell will get over this difficulty, and such a cell may be easily made, as follows: provide two pieces of plate glass about four inches square, and a ring of stout firm india-rubber about two or two-and-a-half inches in diameter. Make up an ounce or two of solution of ammonio-sulphate of copper (by adding ammonia to a solution of sulphate of copper) and having well cleaned the glasses, lay the ring on one of them and pour in as much of the solution as the ring will hold. Now lay the other glass down on the top of the ring, and clamp the plates together either with two pieces of wood at each end connected by screws, or more simply, by means of wagon

makers' iron screw clamps. These will also be found very useful for clamping down the different parts of the apparatus to the base board. An air bubble of varying size will thus be included, but as it rises to the top when the cell is set vertically in position, it does no harm.

When working with artificial light, and objectives of half an inch or less in focus, the foci are practically coincident and a cell will not be needed. If the negatives are not sharp, the cause of error must be looked for elsewhere, either in the faulty illumination of the object (perhaps the most frequent cause), in careless focussing, in unsteadiness of the whole apparatus, or in the objective not having depth of focus enough to bring the different planes of the object into sharp delineation. It must be borne in mind that just as a flat object appears best and sharpest when examined by the microscope, so will be the result in the photograph. If, for instance, the elytra of an insect were sharp, it might be impossible to get the antennæ or extremities of the legs, except by employing a lower power objective, and submitting the negative to further enlargement.

Some authorities have recommended the substitution of a sheet of plate glass for the ground glass of the camera, on the plea that fine de-

tails are obscured by the texture of the latter. There are some difficulties however in the use of plain glass to one who has been used to the ordinary ground glass. In the first place, the image cannot all be seen at once, so that to centre the object is impossible unless a second frame mounted with ground glass be employed. The focussing glasses generally used, and that are of about 4 inches focus, will not answer. A much stronger instrument is required—one, say of ¾ inch focal length, giving greater magnifying power. The image when seen through a glass of this kind, is very brilliant and the finest details are distinctly visible. If it be determined to adhere to ground glass, it will be well to bear in mind Mr. Lea's suggestion of coating a sheet of glass with a solution of rather thin well boiled *starch* free from lumps and sediment. Pour on enough to cover the glass at least one-sixteenth of an inch thick, and keep the glass perfectly level until the starch has set. Then stand it in a warm place to dry. The film thus obtained is not as dense as ground glass, but is of exquisitely fine texture and forms a capital focussing surface.

The question will now arise as to the exposure to be given. No exact rule can be laid down of course. It will vary with the power

of the light, focus of condenser and objective, color of the specimen, sensitiveness of plate, etc., etc. Mr. Carbutt suggests 45 to 120 seconds for his B Keystone plates, but with a one-tenth objective, it may run up to 20 minutes, especially if the specimen be thick and of a yellow or brown color. When working in full sunlight by reflection (where the mirror of the microscope is used) the exposures may not be more than a few seconds. The exposure may be conveniently made by interposing a piece of card in the rear of the stage while the door of the dark slide is drawn out. The card is then removed for the required time and replaced, taking great care not to jar the apparatus, and to wait until any tremor caused by drawing the door has subsided. The photographic manipulations are all conducted as usual, and therefore need not be entered upon here.

APPENDIX.

Routine of Manipulations.—The following tabulated order of Manipulations may serve to prevent hesitation or confusion in those making their first experiments in Photography. Supposing Dry Plates of any kind to be used, we have:

1. Filling the double backs with the sensitive plates in the dark room.
2. Selection of subject and focussing the camera.
3. Insertion of the plate holder, drawing the door, and exposing, by removing the cap of the lens, taking care not to shake the camera.
4. Replacing the cap and door, and returning the holder to the dark room.
5. Development and washing.
6. Fixing and washing thoroughly.
7. Drying.
8. Varnishing.
9. Retouching if necessary.

This does not include intensification; full

directions for this process being given in the chapter on Gelatino Bromide.

The routine for Wet Collodion is slightly different, comprising:

1. Cleaning and albumenizing the glass.
2. Coating with Collodion (by white light).
3. Immersion in the bath (by yellow light).
4. Removal, draining, and setting the plate in the holder.
5. Exposure in the camera.
6. Return to the dark room, and development. (After the plate has been removed from the bath, it must be exposed and developed without loss of time.)
7. Washing after development, and fixing.
8. Washing well, and drying.
9. Varnishing.
10. Retouching.

Recovery of Silver.—A small percentage only of the Silver employed in Photography actually goes to the formation of the image. At the same time, unless the amount of work done be considerable, it is hardly worth while to attempt recovery of the small amounts. In Bath Dry Plate Manufacture, the water in which the plates are first dipped on removal from the bath should be saved. So also should the first wash water of paper prints. Common Salt will

throw down the Silver in the form of Chloride, when added to these washes. This is afterward reduced to the metallic form by fusing in a crucible with Carbonate of Potash and Soda mixed. The Hypo. fixing baths may be boiled with a bar of Zinc, and the precipitate collected, washed, dried, dissolved in Nitric Acid, and precipitated with Salt in the form of Chloride. Waste sensitive paper is burnt, and the ashes dissolved in Nitric Acid and likewise precipitated with Salt. Films from glass plates might be treated the same way. Waste Emulsions may be treated in several ways. They may be boiled with Caustic Potash, or Hydrochloric Acid, either of which will decompose the Gelatine, and on standing, the Bromide of Silver will settle to the bottom in a cake-like mass, so that the supernatant fluid can be decanted off. The waste acids which have been used for making Pyroxyline may also be used for the purpose, or even Sulphuric Acid alone. The Bromide of Silver is reduced to the metallic form like the Chloride. The Iron or Acid Pyro. Developers are only worth saving when a great deal of work is done. The precipitate thrown down is nearly pure Silver, and may be dissolved in Nitric Acid, and thrown down as Chloride as before. Where recovery of

waste is carried on systematically, it is convenient to provide a capacious jar into which all washings containing only free Nitrate of Silver may be thrown. A few drops of Hydrochloric Acid, or a pinch of Common Salt, are added from time to time, and the Chloride of Silver collected, and either sent to a refiner or reduced, as already mentioned. Developers and Fixing Baths must be kept separate from this jar and from each other.

Recovery of Gold.—After the prints have been toned, the bath is thrown into a jar, and an excess of a solution of Sulphate of Iron added. The black powder that falls is collected, washed, dissolved in a mixture of 1 part Nitric Acid to 4 parts Hydrochloric, re-precipitated with Sulphate of Iron, weighed and finally dissolved in the mixed acids as before. Chloride of Gold for toning may be made by dissolving the *pure metal* (not coin) in acids of the given strength.

Transferring Films.—Any film, either of Collodion or Gelatine, may be stripped from the glass, and, if desired, kept in this form. Gelatine Plates receive a Rubber substratum and a coat of Plain Collodion before the Emulsion is poured on. Collodion Plates are prepared with French Chalk and receive no Al-

bumen substratum, the same being done with Washed Emulsion Plates. After the negative is made, a thick solution of Gelatine with a little Glycerine is poured on the film and allowed to dry there, after which, the point of a knife being passed under the film, will lift it, and the whole may be stripped off of the glass together. Collodion films may be transferred by carefully pressing down on them a wet sheet of gelatinized paper. When nearly dry, the paper and film are lifted together off the glass. The negative so stripped may be reattached to glass by coating the glass with Gelatine containing a very small quantity of Chrome Alum. The glass and stripped negative are brought together under water, pressed together with a squeegee, and finally dried. The whole is then set in *hot* water, when the paper floats off from the film, which latter remains firmly attached to the Gelatine on the glass made *insoluble* by the Chrome Alum. This is a great convenience to the travelling photographer. The films may be stripped, as described, leaving the glass ready to be recoated and used. The negatives on their paper supports may be brought home without risk of breakage and reapplied to glass at any convenient time.

Squeegee.—A strip of India Rubber about

⅛ inch thick, set in a wooden frame. It is used as a sort of scraper to flatten prints, etc.

Broken Negatives.—When landscape negatives are broken through parts where there is much half tone or great delicacy, as in skies, etc., little or nothing can be done with them. But broken negatives may often be repaired, by carefully matching the pieces on a plate of glass the size of the original, and touching the edges with Canada Balsam to make them adhere when pushed closely together. After the pieces are in position, a band of paper is pasted all around the four edges of the negative mounted on its glass support. A little black lead may be rubbed into the wider cracks with the tip of the finger after the whole is dry, and pieces of film that have been chipped off at the edges, retouched in with color as well as possible. Prints from a mended negative must always be made in the shade, and will almost always require more or less retouching.

Solarization.—This peculiar defect, appearing as if smoke had passed over parts of the picture, is noticeable where the camera has been pointed against the light. The precise cause of the phenomenon is not understood, but it seems to be more frequent in the case of pure Bromide films than in those contain-

ing an Iodide. Over-exposure will almost always produce it, and it may be lessened to a degree by painting the back of the glass with an opaque, non-actinic color. It seems to be a peculiar property of the film to allow the action of light to spread from the point where it impinges, and so extend to a distance. For this reason care must be taken in pointing the camera directly at any very bright object. Wet Collodion is the most free from this defect of all known processes.

Silver Stains.—The stains made by Nitrate of Silver on linen, etc., etc., may be easily removed by touching the spot with Tincture of Iodine followed after a few moments by a brush charged with a strong solution of Cyanide of Potassium. The Iodine converts the black metallic mark into Iodide of Silver, which is soluble in Cyanide of Potassium, or indeed any fixing agent. In this way the names may be removed from handkerchiefs, if written in the so-called "Indelible Ink."

Removing Stoppers from Bottles.—Gentle tapping with the handle of a spatula on each side of the stopper alternately will often be sufficient. If not, light a spirit lamp and rotate the neck of the bottle in the flame for a moment, so as to expand the neck but not the

stopper, as would take place if heated for a long time. By throwing a thick cloth over the stopper and applying the hollow part of the handle of a key, the stopper will be almost sure to yield. As it would be *very unsafe* thus to heat bottles containing such substances as Ether or Ammonia, a stout thick string may be fastened to a post, and after being encircled two or three times around the bottle neck, given to an assistant to hold. The bottle is then rapidly moved to and fro, and heat generated in this manner.

Kaolin.—White China Clay. A Silicate of Alumina. Used for removing the red color from old Printing Baths.

Binocular Vision.—It may not be generally known that the eyes can be trained to see Stereoscopic views without the aid of the instrument. Nothing need be said of the convenience and pleasure attendant upon the being able to do this. It depends upon a training of the muscles of the eyeballs so that they can be rotated outwardly; or, in other words, made to squint outwardly. Take an ordinary Stereoscopic view and hold it at the level of the eyes, about twenty inches from them and a few feet distant from some small prominent object on the wall of the room. Look fixedly at the

remote object over the top of the slide and the two pictures will apparently move together and coalesce. By gently allowing the eyes to drop to the slide, *three* pictures will be seen, the middle one possessing the characteristic relief of the stereoscope. The eyes may also be trained by holding up the index fingers of each hand about two inches apart. By directing the view to a more remote object, as before, the fingers will apparently approach each other until a single finger with a nail on each side is seen. The distance between the fingers can then be gradually increased to three inches, which is the maximum that the centres of stereoscopic slides should be separated from each other. The trial must not be persevered in for too long a time, otherwise a permanent outward squint might be the result. It may also be well to mention that some persons, notwithstanding repeated efforts, cannot succeed in the matter.

Collo Restrainer.—An excellent substitute for Acetic Acid is made by soaking 100 grains of Gelatine in water enough to cover it, and adding 10 grains of Caustic Potash. The mixture is boiled until a flocculent matter settles to the bottom. This takes about ten minutes. The mixture is then diluted with water until

it measures 9 ounces, and 1 ounce of Acetic Acid No. 8 is added. Of this stock solution, add from half an ounce to an ounce to every twenty ounces of Iron Developer.

Substratum.—A thin layer of Albumen or India Rubber applied to the glass in order to prevent slipping of the film, and to further clean chemical work.

Double Decomposition.—A mutual interchange of chemical composition between two compound bodies, as, for instance, between Nitrate of Silver and Bromide of Ammonium in Emulsion making; Bromide of Silver and Nitrate of Ammonium being formed.

Dead Black Varnish, for the insides of cameras, is made by rubbing together Shellac Varnish with Lampblack. Glue or Gum Water may also be used. Alternate washes of aqueous infusions of Galls and Sulphate of Iron applied to wood produce a deep purple-black color.

Inflammability of Ether.—It must be borne in mind that the vapor of Ether is highly inflammable, and being heavier than air, will sink. A naked flame is never to be set *under* a bottle containing Ether or Collodion.

Spherical Aberration.—The unequal refraction of the rays of light by lenses which are

segments of spheres. It is corrected partly by the curves given to the lens and partly by the use of the stop.

Chromatic Aberration.—In this form of optical defect, the different colored rays of light, instead of being brought to a focus on the same plane as in a perfectly corrected lens, are on different planes, so that when the picture is focussed on the luminous or yellow ray, the actinic point is some distance forward or backward; the negative when made not being sharp. A good many of the lenses made in the earlier days of Photography had this defect, which was compromised by making a number of trials by shifting the ground glass so that it no longer stood on the same plane as the sensitive plate in the holder. When the point was found where a sharp chemical result was obtained, the ground glass was secured in its new position, which was often nearly an eighth of an inch distant.

Pyroxyline.—Another name for the Soluble Gun Cotton used in Collodion. It is not the highly explosive variety, though very inflammable.

Stock Solution.—A solution made up generally in different proportions from that of the working strength, so that a certain amount can

be measured out when required, and save the repeated use of scales and weights. They are, of course, made only of such articles as keep well.

Saturated Solution.—A liquid containing so much of a given substance that no more can be made to dissolve.

C. P.—An abbreviation for the words Chemically Pure.

Septum.—A partition or division. A term applied to the central divisions in Stereoscopic cameras. They should always be arranged so that they can be taken out if desired and a picture made on the full size of the plate.

Focus or Focal Length.—The point at which rays of light are brought together and condensed by a convex lens. The Focal Length, more strictly speaking, is the distance of this point from the centre of the lens. It determines the size of the image.

Stop or Diaphragm.—A piece of perforated metal fitted between the combinations of a lens (generally) to regulate the amount of light admitted, and the obliquity of the rays. For an explanation of the expressions $F/_{12}$, $F/_{11}$, etc., see Chapter II.

Refraction.—The change of direction suffered by a ray of light on its passage into a

medium of different density. It takes place at the surfaces only of the media, and affects only those rays striking at an angle.

Finders.—A good and cheap substitute for a duplicate lens, as described in Chapter X., is a means devised by Mr. L. T. Young, of Philadelphia, where a small French focussing glass was arranged with a small ground glass at the wide end of its own tube, and the whole affair mounted at the side of the camera. While the image was of reduced size, it was nevertheless perfectly easy to tell just the amount of subject included on the ground glass of the camera.

Ferrotype.—A Positive Collodion Photograph made on a plate of Iron covered with a jet black varnish. Not to be confounded with Ferro-prints or blue-prints. (See Chapter IX.) The manipulations of Ferrotype-making are identically those of the Wet Collodion negative, a slightly thinner Collodion, and weaker developer containing more acid being used.

Reproducing Negatives.—A Transparent Positive is made (best on a Gelatine or Washed Collodion Emulsion Plate), and from this a negative, either by contact or in the camera (Chapter IX.). The Positive must be fully timed, not over-developed, and without very

great density. Absolute sharpness and freedom from fog and defects of all kinds are essential. Washed Emulsion may also be used for making the negative, and if the latter is to be enlarged or reduced, the camera must be employed.

Poisons.—Cyanide of Potassium, Bichloride of Mercury, and the Oxalates are largely employed in Photography. The Mineral Acids and Ether would also rank in this category, but the former three are those from which danger is most to be feared. If Cyanide of Potassium is swallowed, the proper antidote is a mixture of a few grains of Sulphate of Iron, a teaspoonful of Tincture of Chloride of Iron, and a pinch of Carbonate of Potash. Cautious inhalations of Chlorine or Ammonia are to be made, and particularly a *cold douche to the nape of the neck*. Hypodermic injections of Sulphate of Atropia have been suggested, and frictions and artificial respiration are not to be forgotten. It must be borne in mind that Cyanide of Potassium poisons when absorbed into the skin through cuts, etc., and when its vapor is inhaled. The treatment is the same as when swallowed.

The proper antidote for Bichloride of Mercury is Albumen in any form. If eggs can-

not be obtained, large quantities of milk, blood, or even flour, may be given. Vomitin should be encouraged at first.

Oxalic Acid and the Oxalates if swallowed, should be gotten rid of by first promoting vomiting, and afterwards giving Lime in any form. *Not soluble alkalies such as Soda or Potash*, for these being soluble retain the poisonous properties.

Chalk or Magnesia should be given if Mineral Acids are swallowed. The best safeguard against Ether is to have free ventilation in the dark room.

All poisons should be distinctly labelled and put in places where children or ignorant persons cannot find them. A review of the Photographic Journals will show that these cautions are not superfluous.

Failures such as will be made by the beginner, when Gelatine Plates are used, will be principally attributable to the timing and the development. The paramount importance of making both of these factors work harmoniously together, as well as the latitude allowable in each, have been sufficiently treated of. It merely remains to indicate a few points which might puzzle the beginner.

Universal thinness and weakness of the whole

picture with no proper gradation between the lights and half tones, is generally caused by over exposure and under development. The image appearing rapidly under the developer, the plate is removed before there has been time for the necessary density to appear. Remedy: more Bromide and Pyro. in the developer, or if Ferrous Oxalate be used, more Bromide and longer immersion.

Hazy Indistinctness or Fog, if not caused by stray light gaining access to the film, or by too prolonged action of the developer, is probably an evidence of a spoiled Emulsion. The plates had better be returned to the maker.

Frilling or Puckering of the Film, if not controlled by the Alum Bath (page 91), is also proof of a bad Emulsion.

Air Bubbles adhering to the Film, when the developer is first poured on, will of course prevent its action, and make a perfectly transparent hole in the film.

Spots and Pinholes, if appearing in spite of careful dusting off of the plate, are also caused by something wrong in the Emulsion or in the drying of the plate when prepared.

Markings and Streaks generally are to be ascribed to the same cause. But a *deep whitish yellow mark* is caused by imperfect removal of

the Bromide of Silver by the fixing bath. *A thick whitish yellow appearance of the whole plate* may be caused by actinic light gaining access to the film before the fixing bath has thoroughly done its work. (See page 94.)

Failures during Intensification are generally the result of imperfect removal of the Hypo-sulphite of Soda or the Mercury from the film. It must be borne in mind that a glutinous body like the Wet Gelatine film retains chemicals that have once penetrated it with extreme tenacity. With such plates as have very thick films, it might be impossible to get rid of all traces of Hypo. by means of water only. It is for this reason that the Alum and Citric Acid bath should always be used before applying the Mercury.

Dark Edges or Borders on the negative unless caused by stray light are proof of bad plates. The cause is not understood.

Entire Fading Out of the Image seems to be caused either by impurities in the water used for washing the plate, or more probably by some impurity in the atmosphere (sulphurous gases,

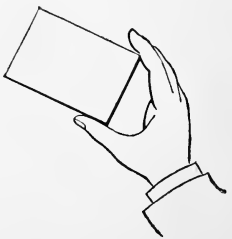

Fig. 18.

etc.) to which the plates are exposed, particularly if there is dampness present.

The plates should always be handled by the edges, as represented in Fig. 18, so as not to injure the film, which, although hard enough to resist some friction, is very susceptible to chemical impurity of any kind. The imprint of a sweaty finger is often seen in the work of careless individuals. Fig. 19 represents a handy little instrument for lifting the plate out of trays, etc., without risk of injuring the film.

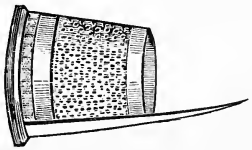

FIG. 19.

Weights and Measures.

APOTHECARIES' OR WINE MEASURE.

60 Minims	make	1 Fluid Drachm.
8 Fluid Drachms	"	1 Fluid Ounce.
16 Fluid Ounces	"	1 Pint.
8 Pints	"	1 Gallon.

The English Imperial Pint contains 20 Fluid Ounces and weighs 1¼ lbs. Avoirdupois.

APOTHECARIES' WEIGHT.

20 Grains	make	1 Scruple.
3 Scruples	"	1 Drachm.
8 Drachms	"	1 Ounce.
12 Ounces	"	1 Pound.

In this weight the Pound, the Ounce, and the Grain are the same as in Troy Weight.

The above weights are used by photographers in making up solutions, etc., unless otherwise expressly stated. It should be borne in mind, however, that Photographic Chemicals are sold, as usual, by Avoidupois Weight, the Ounce of Nitrate of Silver containing 437½ grains, etc. As the precious metals are sold by Troy Weight, the ounce of *metallic* Silver will contain 480 grains.

As the Continental or Decimal System of Weights and Measures is becoming more and more used, the following Tables for its reduction to English Weight may be useful:

FLUID MEASURE.

1 cubic centimètre	=	17 minims (as near as possible).								
2 cubic centimètres	=	34	"							
3	"	=	51	"						
4	"	=	68	"	or	1	drachm	8	minims.	
5	"	=	85	"	"	1	"	25	"	
6	"	=	102	"	"	1	"	42	"	
7	"	=	119	"	"	1	"	59	"	
8	"	=	136	"	"	2	drachms	16	"	
9	"	=	153	"	"	2	"	33	"	
10	"	=	170	"	"	2	"	50	"	
20	"	=	340	"	"	5	"	40	"	
30	"	=	510	"	"	1	ounce	0	drachm	30 min.
40	"	=	680	"	"	1	"	3	drachms	20 "
50	"	=	850	"	"	1	"	6	"	10 "
60	"	=	1020	"	"	2	ounces	1	"	0 "
70	"	=	1190	"	"	2	"	3	"	50 "
80	"	=	1360	"	"	2	"	6	"	40 "
90	"	=	1530	"	"	3	"	1	"	30 "
100	"	=	1700	"	"	3	"	4	"	20 "

SOLID MEASURE.

1 gramme	=	$15\frac{2}{5}$	grains.					
2 grammes	=	$30\frac{4}{5}$	"					
3 "	=	$46\frac{1}{5}$	"					
4 "	=	$61\frac{3}{5}$	"	. . . .	or	1	drachm	$1\frac{3}{5}$ grain.
5 "	=	77	"	. . . .	"	1	"	17 grains
6 "	=	$92\frac{2}{5}$	"	. . . .	"	1	"	$32\frac{2}{5}$ "
7 "	=	$107\frac{4}{5}$	"	. . . .	"	1	"	$47\frac{4}{5}$ "
8 "	=	$123\frac{1}{5}$	"	. . . .	"	2	drachms	$3\frac{1}{5}$ "
9 "	=	$138\frac{3}{5}$	"	. . . .	"	2	"	$18\frac{3}{5}$ "
10 "	=	154	"	. . . .	"	2	"	34 "
11 "	=	$169\frac{2}{5}$	"	. . . .	"	2	"	$49\frac{2}{5}$ "
12 "	=	$184\frac{4}{5}$	"	. . . .	"	3	"	$4\frac{4}{5}$ "
13 "	=	$200\frac{1}{5}$	"	. . . .	"	3	"	$20\frac{1}{5}$ "
14 "	=	$215\frac{3}{5}$	"	. . . .	"	3	"	$35\frac{3}{5}$ "
15 "	=	231	"	. . . .	"	3	"	51 "
16 "	=	$246\frac{2}{5}$	"	. . . .	"	4	"	$6\frac{2}{5}$ "
17 "	=	$261\frac{4}{5}$	"	. . . .	"	4	"	$21\frac{4}{5}$ "
18 "	=	$277\frac{1}{5}$	"	. . . .	"	4	"	$37\frac{1}{5}$ "
19 "	=	$292\frac{3}{5}$	"	. . . .	"	4	"	$52\frac{3}{5}$ "
20 "	=	308	"	. . . .	"	5	"	8 "
30 "	=	462	"	. . . .	"	7	"	42 "
40 "	=	616	"	. . . .	"	10	"	16 "
50 "	=	770	"	. . . .	"	12	"	50 "
60 "	=	924	"	. . . .	"	15	"	24 "
70 "	=	1078	"	. . . .	"	17	"	58 "
80 "	=	1232	"	. . . .	"	20	"	32 "
90 "	=	1386	"	. . . .	"	23	"	6 "
100 "	=	1540	"	. . . .	"	25	"	40 "

Very convenient scales are now manufactured with movable pans, and with a metallic index graduated into both grains and grammes, with a sliding piece whereby the weight is marked.

When weighing small quantities, the scales must stand level and be protected from draughts of air. The beam must move with the most perfect freedom, and if it be set low, nothing should interfere with its full descent. If for any reason the scales should not balance perfectly at the moment of weighing, a few grains of sand may be dropped on either pan. It is presupposed that two papers cut to the same size be laid on the pans to protect them from injury. Avoid breathing on the scales while weighing.

In measuring liquids in graduated measures, hold the measure *level at the height of the eye*, and pour the liquid in until the lowest part of its curved surface reaches the mark. Never set the measure on a table and judge of the contents while standing.

In graduated measures of the sizes that the amateur will be apt to buy, the fluid drachms, denoted by the symbol ʒ, will stand at the right of a broad upright line with figures corresponding. The fluid ounces, denoted by ℥, will stand at the left of the upright line. If the measure be of large size, the symbols for drachms and ounces will be replaced by those for ounces and pounds standing in the same order.

Mailing Photographs.

Photographs with the titles written upon them rank as third class matter, if mailed in *unsealed* packages (*i. e.*, wrapped and tied with a string, or secured with elastic bands, leaving one end open). Postage, one cent for every two ounces or fractional part thereof.

Preservation of Clouds and Distances in Landscapes.—It is manifest that the brilliant light of the clouds and distant objects will impress the film long before the details in the foreground (which are almost always dark) have received the proper exposure. The best and simplest means of obviating this, is to shield the upper part of the lens with the cap, giving to the latter a slight to and fro movement so as to prevent unequal action. The cap should be held close to the lens—almost touching it—and if the total exposure is to be, say, twenty seconds, give the sky from five to eight, then shield with the cap for the remainder of the time. The clearness of the rest of the view will be improved by thus keeping the lens shielded from the glare of the sky throughout more than half the exposure, as can be seen by looking at the ground glass with the cap held in the aforesaid position.

INDEX.

THE END.

S.